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PAPERS ON IOWA FUNGI III

The Validity of the Genus *Pilaira*

by

ROBERT S. ANDERSON

The Genera of the Dacrymycetaceae

by

G. W. MARTIN and M. C. FISHER

A Morphological Study of Certain Species of *Tremella*

by

ALPHA MAE LOONEY

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THE VALIDITY OF THE GENUS PILAIRA

ROBERT S. ANDERSON

The genus *Pilaira*, as established by van Tieghem,¹ was recognized as closely related to *Pilobolus*, and as similar to that genus in the character of the sporangium wall, which is entirely cuticularized except for a ring immediately below the insertion of the columella. In *Pilobolus*, however, the sporangium is shot into the air at maturity, breaking at the noncuticularized ring. The rupture is caused by the increasing pressure of the contents of the sporangiophore and this pressure is correlated with the characteristic swollen tip of that organ. In *Pilaira*, on the other hand, the sporangium, instead of being shot off, is merely raised by the lengthening of the sporangiophore to a height of ten or twelve centimeters and then either falls off or is detached by contact with any foreign object. Four species of *Pilaira* are listed in Saccardo's *Sylloge Fungorum*. Fitzpatrick,² however, in his recent treatment questions the validity of the genus, suggesting that the species described may have been based on abnormal developments of *Pilobolus*. In view of this statement it seemed worth while to re-investigate the matter. The studies were made in the mycological laboratory of the State University of Iowa, under the direction of Professor G. W. Martin.

Both *Pilobolus crystallinus* and *Pilaira anomala* occur commonly on rabbit dung collected in the vicinity of Iowa City when placed in moist chambers. Each lot of dung was carefully wrapped when collected, and every precaution was taken to exclude contamination. In most cases sporangia appeared in from two to five days—the *Pilaira* usually in two days, the *Pilobolus* in three or four.

Small glass bottles were sterilized by holding them over an open flame for two minutes. A single sporangium was introduced into each bottle, which was then plugged with cotton and marked. *Pilaira* sporangia were taken from fresh cultures by means of flamed forceps filed to needle points. In the case of *Pilobolus*, new sterile covers were put on the culture dishes when the sporangia

¹ Ann. sci. nat. bot. (VI) 1 : 51. 1875.

² The Lower Fungi. Phycomycetes. 253. 1930.

were mature; the sporangia adhered to these when shot off and could be transferred to the bottles by means of a flamed platinum needle. In all cases the sporangia were crushed and the bottles set aside in a window exposed to sunlight for one week.

A dung agar medium was prepared as follows: a 250 cc flask was filled with rabbit dung, as much water added as it would hold, and the whole heated in the autoclave at 15 lbs. pressure and allowed to stand for 24 hours. The water, about 200 cc, was then filtered off, 3 gms. of agar added and placed in a liter flask plugged loosely with cotton. The large flask seemed necessary to prevent the medium from boiling over. This flask was then put into the autoclave and brought up to 15 lbs. pressure. The melted medium was poured into Petri dishes and resterilized.

To make inoculations, 80 cc of water was added to an equal bulk of rabbit dung, the mixture boiled and the liquid filtered off and reesterilized. Ten cc of this liquid was added to each of the bottles containing crushed sporangia, and the bottles were shaken to insure complete distribution of the spores. They were then put into an incubator and kept at 36° C. for ten hours, after which they were taken out and the contents of each poured into one of the Petri dishes containing the dung agar medium. After standing for twenty minutes the excess water was poured off.

The following day two of the plates contained colonies of *Pilaira* developed from single spores. These were removed to a new Petri dish. Four days later typical *Pilaira* sporangiophores appeared on all the single spore cultures, and these were maintained without difficulty by transfers. None of the *Pilobolus* spores had germinated, however, so the process was repeated for *Pilobolus*, modifying the procedure by putting the bottles in the incubator for varying periods ranging from four to twenty-four hours. Seven days later *Pilobolus* sporangia appeared in a plate which had been left in the incubator for eight hours. Unfortunately it was contaminated and the *Pilobolus* was therefore not secured in pure culture, but the evidence seemed to point clearly to the conclusion that the two genera were distinct.

To test the matter in a different way, a rabbit was procured and dung from his pen was put into moist chambers to determine whether either *Pilaira* or *Pilobolus* was present. As neither appeared after seven days, the pen was carefully cleaned and a few sporangia of *Pilobolus* were put on a piece of lettuce which was

fed to the rabbit. Dung was collected from the pen during the succeeding twenty-four hours and placed in Petri dishes. With very few exceptions, each piece developed numerous *Pilobolus* sporangia and no *Pilaira*. A second rabbit was isolated in a different pen and tested for one week with negative results. Then *Pilaira* sporangia were fed on lettuce and the dung deposited during the next day cultured. Copious growths of *Pilaira* developed, but no *Pilobolus*.

In culture *Pilobolus* occasionally produces sporangia which somewhat suggest those of *Pilaira* (fig. 2) but this resemblance is purely superficial. The sporangia are always shot off. Since the two genera are constantly distinct in culture and since the feeding experiments showed no trace of intermediate forms it is concluded that the genus *Pilaira*, as defined by van Teighem, is unquestionably valid.

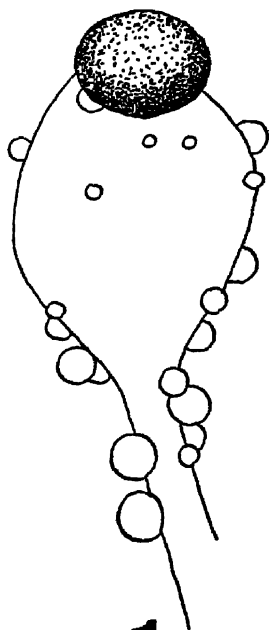
DESCRIPTION OF PLATE

All figures x 22.

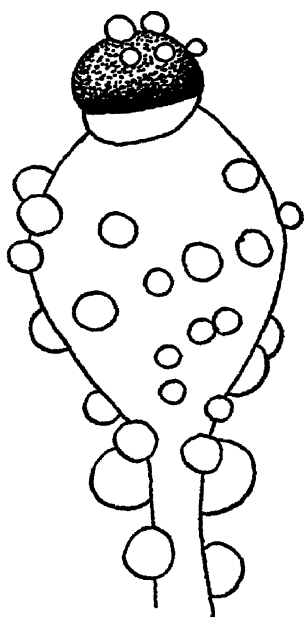
Fig. 1. *Pilobolus crystallinus*. Typical sporangium and tip of sporangiophore.

Fig. 2. *Pilobolus crystallinus*. Aberrant sporangium, with lower portion as in *Pilaira*, but borne on a typical swollen sporangiophore.

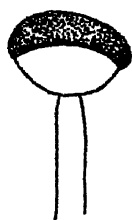
Figs. 3-8. *Pilaira anomala*. Showing variation in sporangia.



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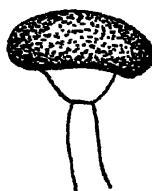
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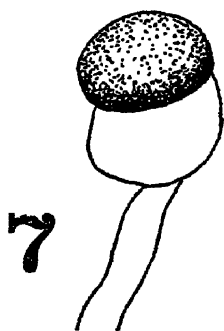
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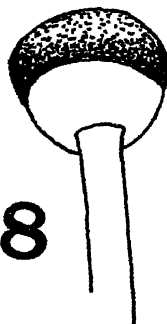
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THE GENERA OF THE DACRYMYCETACEAE

G. W. MARTIN and M. C. FISHER

The family Dacrymycetaceae was established by Brefeld in 1888 (2) to include those tremellaceous fungi in which the mature basidia are furcate, the cylindrical base giving rise to two thick branches, often called sterigmata, but which are better referred to as epibasidia, each of these being tipped by a true sterigma and a spore. The family itself is adequately characterized by its distinctive basidia, but within the family the generic distinctions are by no means clearly defined. Because of that fact it seems desirable to present a key to the genera which seem worthy of recognition, with brief comments on these.

Many of the Fungi included in the family have long been familiar. In the *Systema mycologicum* and *Elenchus fungorum* Fries mentions several genera and a number of species, but because of his relative neglect of microscopic characters they are not coherently grouped. Tulasne (12) was the first to demonstrate the peculiar characteristics of the basidia of the group but did not propose taxonomic readjustment. Brefeld, in erecting the family, regarded it as the lowest family of the Autobasidiomycetes, recognizing, however, its close relationship with the Tremellaceae. Patouillard (10) reunited the family, as the Caloceraceae, with the tremellas, rusts and smuts, in his group Heterobasidiaceae. Hennings (6) follows Brefeld, but most later writers, including Coker (3), Rea (11), Bourdot and Galzin (1), and Killermann (7), have adopted Patouillard's view. In Gäumann and Dodge (5) the family is regarded as constituting an independent order, coördinate with the Cantharellales of their treatment, both groups being derived independently from the Ascocorticium group. It is not our purpose to discuss at this time the arguments offered in support of these various viewpoints, since all recognize the distinctness of the family itself.

The following key is intended to make possible the recognition of the nine genera which seem to be fairly clearly definable:

- a. Fructification broadly effused, thin; surface smooth; waxy when moist 1 *Arrhytidia*
- a. Fructification pulvinate, cupulate or more or less pileate and erect b
 - b. Sessile, or with a root-like base immersed in the substratum c
 - b. Erect, narrowly attached, usually stipitate and pileate d
- c. Discoid or pulvinate, often becoming cerebriform; attached by a point or more or less rooted 2 *Dacrymyces*
- c. Cupulate; tough gelatinous; spores large, becoming many-celled; hymenium inferior 3 *Femsjonina*
- d. Erect, subulate, simple or branched; hymenium covering entire exposed portion, hence stipe practically lacking 4 *Calocera*
- d. Stipitate and pileate e
- e. Pezizaeform; stipe short, thick, gelatinous except at base, which is fibrous; cortex of swollen, capitate cells; hymenium superior 5 *Heterotextus*
- e. Not pezizaeform; stipe tough; cortex not composed of swollen, capitate cells f
 - f. Pileus subglobose or flattened as in *Dacrymyces* g
 - f. Pileus not as in *Dacrymyces* h
- g. Stipitate or substipitate, the white fibrous, tough stalk separating into branches and deeply penetrating the substratum 6 *Ditiola*
- g. Stalk tough-gelatinous, cylindrical, not deeply rooting; head flattened 7 *Dacryopsis*
- h. Gelatinous, with a stout stalk and a swollen morehella-like, usually conical hymenophore 8 *Dacryomitria*
- h. Tough or cartilaginous; spatulate or cupulate; hymenium unilateral, inferior; stem more or less lateral 9 *Guepinopsis*

1. *ARRHYTIDIA* Berkeley

Hooker's Jour. Bot. 1:234. 1849.

In configuration of the hymenium, this genus is similar to *Corticium* among the Hymeniales. Berkeley's diagnosis is very unsatisfactory. He believed the genus to be close to *Merulius*. He sent a portion to Fries, however, and the latter (*Novae Symbolae Mycologicae* p. 114, 1851) noted its relationship to *Dacrymyces*. This is confirmed by Lloyd (*Myc. Writings* 6: 899, 1919), who saw the type in Europe.

In 1885 Cragin published the genus *Ceracea* (*Bull. Washburn College Lab. Nat. Hist.* 1: 82). Cragin's diagnosis was copied in the *Journal of Mycology*, 1: 58, the same year, and this is often incorrectly cited as the place of publication. Cragin's name has been generally adopted, but his diagnosis is no better than Berkeley's, and since Berkeley's name was validly published, and the material upon which it was based has been verified by Fries and by Lloyd, *Arrhytidia* is clearly to be preferred. Cragin's type has apparently been lost.

The only specimens available to us for study are those distributed by Krieger as *Ceracea aureo-fulva* Bres., *Fungi saxonici* 1909. This material is characterized by a very flat, irregularly discoid fructification, the disks mostly less than a centimeter in diameter, but often much larger, up to 10 cm., the larger growth being apparently by confluence. The attachment is by a central point, the rest of the lower portion merely appressed to the substratum and following its irregularities. Von Höhnelt regards it as the same as *Dacryomyces confluens* Karst. However, the texture is waxy, not gelatinous, and the spores are 1-septate, both of which characters suggest *Arrhytidia*. A typical *Arrhytidia* would undoubtedly be more broadly attached.

2. DACRYMYCES Nees ex Fries

Syst. Myc. 2:228. 1823.

Nees wrote *Dacryomyces* and his spelling has commonly been adopted. Fries, however, maintained his spelling in several later works, suggesting that the change was intentional, and since it is not etymologically incorrect, this usage should be followed.

Dacryomyces is the best-known genus of the family and includes several of our commonest species. Nevertheless, the limits of the genus have not been clearly defined, and it has been confused with *Femsjonia*, *Heterotextus*, *Ditiola* and *Dacryopsis*. Most descriptions allude to the pileus as completely covered by the hymenium. This is incorrect, as the free portions which are not exposed to the air are always sterile. This is well brought out in the discussion and illustrations of Fisher (4). Since the attachment is always narrow, the lower portion of the hymenophore is always contracted at the base, which may be a mere point of attachment or may merge into a fibrous, root-like portion, but neither stem nor root are sharply delimited, as in the other genera named. Once the characters are understood, it is usually easily distinguished from all but *Ditiola*.

3. FEMSJONIA Fries

Summa Veg. Scand. 341. 1849.

The original description is as follows: "Cupularis, gelatina firma distenta, heteroplaca, subtus villosa, disco crasso discreto gelatinoso laevi, sporophoris immersis monosporis, sporis secedentibus."

Emphasis is here placed upon the cup-like character and the

smooth, gelatinous hymenium. Later writers, in discussing the genus, have emphasized the large spores, which before germination become divided into 12 to 20 or more cells. The cup-like fructification suggests *Heterotextus*, from which genus it is separated, however, according to the descriptions, by the lack of a firm, stem-like base, the absence of the capitate cortical hairs, the inferior hymenium and the large multi-septate spores. Istvanffi's figure, in Brefeld, shows a peziza-like base with a distinct margin, and the hymenium superior. Buller (Res. II, p. 165) publishes a photograph in which the margin is less apparent, and states that the hymenium is always directed downward. Our diagram is based on his statement and photograph. The cortex is evidently distinct from the interior, but Lloyd, who knew *Femsjonina* and established *Heterotextus*, thought them distinct. We have seen no examples.

4. CALOCERA Fries

Syst. Myc. 1:485. 1822.

Clearly diagnosed in the original description, although placed between *Clavaria* and *Geoglossum*, since Fries paid little attention to microscopic characters. Tulasne seems to have been the first to point out its true relationships (12). Usually spoken of as stipitate but Fisher has shown that our common species, *C. cornea*, is practically stemless and we assume that that is true of other members of the genus. In any event, the erect, narrowly attached, subulate fructifications are easily recognizable.

Calocera striata, as illustrated by Istvanffi in Brefeld's treatment, has a distinct stalk and a swollen, long-conical head marked with longitudinal striations, strongly suggesting *Dacryomitra pusilla* as illustrated by Tulasne, and if not that species, would at least seem to be congeneric with it.

5. HETEROTEXTUS Lloyd

Myc. Writings 7:1151. 1922.

The distinctive cortical cells characterize this genus satisfactorily, and it is not likely to be confused with any other after microscopical examination. Very old basidiocarps became highly deliquescent and suggest old fructifications of *Dacrymyces*, but even in such the cortical hairs persist. The genus has been discussed in a recent paper by Martin (9). It is there stated that

the hymenium is probably inferior. Professor Paul F. Shope of the University of Colorado, who has collected a typical species abundantly, informs us that in his experience the hymenium is always superior.

6. DITIOLA Fries

Syst. Myc. 2:169. 1823.

As originally described, this genus was placed with more or less gelatinous Ascomycetes, following Bulgaria. In the *Elenchus fungorum* 2:17, 1828, note is made of its possible dacrymycetaceous affinities. The best-known species, *D. radicata*, has been studied by Lindau (8) and his treatment and figures are usually copied. It is undoubtedly close to *Dacrymyces*, differing in the more globose head and the short but firm stalk which merges into a usually branching, deeply-penetrating root.

7. DACRYOPSIS Massee

Jour. of Mycology 6:180. 1891.

This genus is like *Dacrymyces* in the character of its head, but it has a stalk resembling that of *Dacryomitra* but tougher and more cylindrical, which is little or not at all rooted, as contrasted with that of *Ditiola*. There has been a tendency in recent years to discard this genus, merging it with *Ditiola* and *Dacryomitra*, but we believe it should be retained provisionally, pending further study, as stated by Fisher. The citation *Grevillea* 20:24, 1891, sometimes given for the genus, is incorrect, as this is merely a copy of the earlier publication in the *Journal of Mycology*.

8. DACRYOMITRA Tulasne

Ann. Sci. Nat. Bot. 5 ser., 15:217. 1872.

Based on a species, *D. pusilla*, described and illustrated as erect, 8-10 mm. tall, with a gelatinous stem and somewhat swollen, clavate, conical pileus. The latter is marked by broad, shallow, longitudinal, anastomosing ribs. A second species, *D. glossoides*, was described by Brefeld (2) as having a broadly conical or rounded head, with much more pronounced ribs, giving it a strikingly morecheloid appearance. His species is much larger, attaining over 30 mm. in height. The drawing by Istvanffi accompanying Brefeld's description is the illustration of the genus commonly reproduced. Brefeld also notes that the spores of this genus be-

come 3-septate before germination while those of *Calocera* become 1-septate only, but the value of such a character as a generic distinction in the present family is distinctly subordinate. Bourdot and Galzin say the head may be either morecheloid or smooth, which again raises the question of the distinction between this genus and *Dacryopsis*. Note also the comment on *Calocera striata*.

We have not seen authentic specimens, although a small form occasionally collected in Iowa may belong to this genus, but the illustrations and descriptions of Tulasne and Brefeld seem to justify the retention of the genus as well as the segregation from it of *Dacryopsis*.

9. GUEPINIOPSIS Pat.

Hyménomycètes, d'Europe 159. 1887.

This is the genus to which Fries' name *Guepinia* is often applied. Fries, however, founded the genus on the large funnel-shaped form often known as *Gyrocephalus rufus* which has longitudinally septate basidia; hence *Guepinia* is a genus of the Tremellaceae, and *Guepiniopsis* must be used for those gelatinous fungi with basidia of the dacrymycetaceous type commonly referred to *Guepinia* (see Martin, 9).

Fisher (4) has recently studied the two species occurring in Iowa, *G. spathularius* and *G. elegans*. The tough gelatinous, almost rubbery consistency of the pileus, the definite stalk and the sharp delimitation of the hymenium to the inferior side of the pileus make this genus easy of recognition.

Doubtful genera

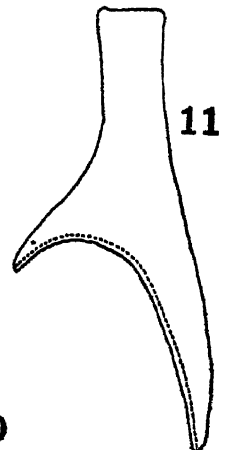
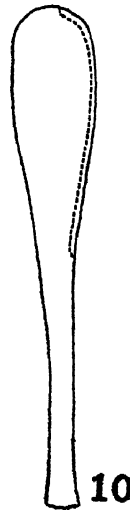
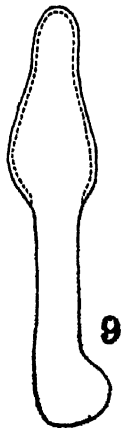
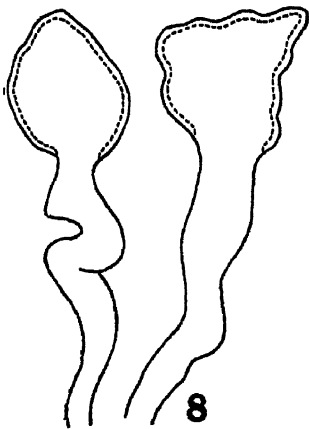
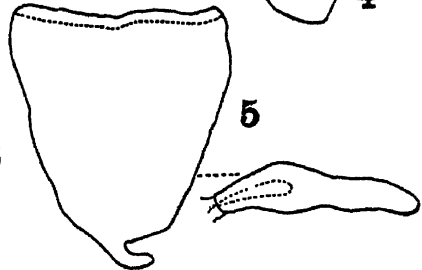
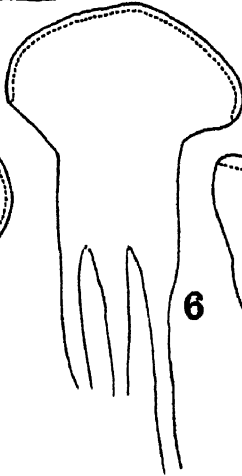
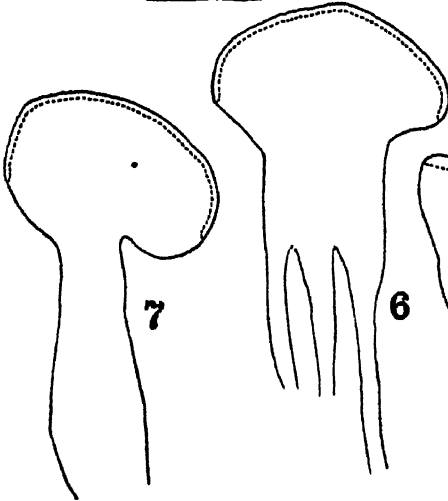
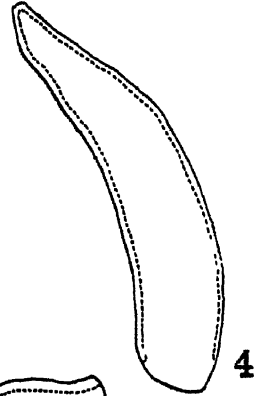
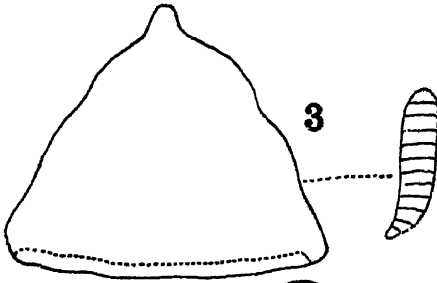
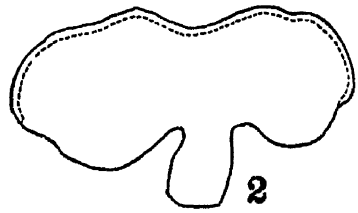
The genera *Apyrenium*, *Collyria*, *Myxomycidium*, *Hormomyces* and *Cladosterigma* are listed as doubtful genera by Killermann (7). Of these, *Myxomycidium* Massee is said to be merely a pendent *Calocera*. The others are probably not to be included in the Dacrymycetaceae.

Dacryopsella v. Höhnelt is an Hymenomycete, as shown by an examination of the type collection.

DESCRIPTION OF PLATE

All figures diagrammatic to show relation of hymenium, hymenophore and stipe, if present.

- Fig. 1. *Ceracea aureo-fulva* Bres., x10.
- Fig. 2. *Dacrymyces deliquescens* Fr., x17.
- Fig. 3. *Femsjonina luteo-alba* Fr., x5, Diagrammatic section based on descriptions and illustrations of Brefeld and Buller.
- Fig. 4. *Calocera cornea* Fr., x 12.
- Fig. 5. *Heterotextus alpinus* (T.&E.) Martin, x5.
- Fig. 6. *Ditiola radicata* Fr., x6. After Lindau.
- Fig. 7. *Dacryopsis nuda* Massee, x12.
- Fig. 8. *Dacryomitra glossoides* Bref., x2. After Brefeld.
- Fig. 9. *Dacryomitra pusilla* Tul., x5. After Tulasne.
- Fig. 10. *Guepiniopsis spathularius* (Fr.) Pat., x6.
- Fig. 11. *Guepiniopsis elegans* (Fr.) Pat., x 6.



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A MORPHOLOGICAL STUDY OF CERTAIN SPECIES OF TREMELLA

ALPHA MAE LOONEY

This study was suggested by the great confusion existing in the Tremellaceae and particularly in Tremella, its type genus. The tremellas have never received adequate attention, a circumstance due probably to the fact that it is only during or immediately after wet weather that their fructifications are conspicuous, these structures at other times drying to mere films or at most shrivelled skeletons of the forms assumed under moist conditions. Although the fructification produces spores only when in an expanded state, the wood-inhabiting mycelium is active for a much greater part of the time and a number of these fungi have been suggested as important wood-rotting organisms.

The genus Tremella, so named by Dillenius in 1741 because of its soft, tough, quivering texture, was conceived in a very wide sense. Pre-Friesian authors generally included in it nostocs, lichens, tubercularias and even Gymnosporangium. Their descriptions, deplorably scanty, are practically useless except when accompanied by illustrations. Bulliard, however, gave full descriptions, accompanied by unusually satisfactory illustrations. Though many of the forms he included in the genus are not now regarded as tremellas, he did have an idea of the great variation possible within the species. Persoon (25) in 1801 excluded aquatic forms as algae. He retained twenty-five species, most of which are now placed in other genera, and divided them into four groups, the division based wholly on form. Albertini and Schweinitz (1, 1805) and Martius (20, 1817) made unimportant modifications of Persoon's grouping. By the time of Link (17, 1833) the genus had been fairly well cleared of the obviously erroneous inclusions. He provides a useful synonymy.

Fries (13, 1823) put into more logical form the work of his predecessors. His classification was largely on the basis of form and texture. By the exclusion of Exidia, Naematelia, Daecrymyces, Agyrium, and Hymenella from the genus Tremella it was greatly narrowed; even so, it included a number of foreign species and

synonyms. The genus was divided into three tribes: Hygromitroideae (stipitate and expanded into a head), with one species; Mesenteriformes (caespitose, foliately expanded, flaccid, naked), with five species, and Cerebrinae (pulpy-gelatinous, turgid, at first subcompact, pruinose with spores), with six species. His subdivision Coryne, synonymous with Persoon's *Acrospermum*, included certain species regarded as helotiums by Persoon. The other subdivision, Phyllopta, included forms parasitic on living fungi, and is, according to Fries, related to *Sclerotium*.

Thirty years after this work of Fries came that of the Tulasnes. In 1853 L. R. Tulasne published observations on certain tremellaceous forms (28). Though his taxonomic conclusions were fallacious in some cases, his accurate observations, clear discussions and drawings make this a work of fundamental importance.

Brefeld (5, 1888) recast the genus on the basis of spore shape. After separating species of *Exidia*, *Ulocolla*, and *Craterocolla*, the last two genera created by himself, only "round-spored" forms remained. *Naematelia* was included in *Tremella*. Brefeld is regarded by many as the great morphologist of the Tremellales, consequently, his taxonomic following is very extensive. It appears, however, that many points emphasized in his taxonomic decisions are of little or no significance.

Winter (29, 1884), using Fries' generic classification, with some modifications, retained the divisions *Cerebrinae* and *Mesenteriformes*; his *Tuberculiformes*, small erumpent forms, and *Crustacea*, flat fructifications, seem both to have been segregated from *Cerebrinae*. Winter did not separate forms with separate conidial fructifications.

The work of A. P. Morgan (21, 1888) of Ohio, territorially limited and with only brief descriptions, is of significance only as one of the first attempts in this country to classify the Tremellaceae of a particular area.

Berkeley and Curtis did little of critical nature with the tremellas. The same might be said of Cooke, whose work was not sufficiently accurate and thorough to be of value. He followed Brefeld in his classification.

The work of Patouillard (23, 1900) has been unduly neglected in this country. He adopted Karsten's *Ditangium* for forms with separate conidial fructifications. He included *Naematelia* in *Tremella* and divided the genus into (A) *Foliaceae*, with erect,

variously contorted lamellae, (B) Cerebrineae, with obtuse and contorted veins on the surface, (C) Crustaceae, expanded and with smooth surface (e.g. *T. nucleata*), and (D) Tuberculiformes, minute fructifications appearing as round or flat tubercles.

In America, in the last twenty years, a number of mycologists have studied the Tremellales. Gilbert (14, 1910) presented descriptions, discussions and a history of the group as represented in Wisconsin, accompanied by a most excellent bibliography. Coker (8, 1920), of North Carolina, worked on the species of his state. Burt's notes (7, 1921) on the Tremellales are very accurate. Lloyd's voluminous notes, resulting from an extensive examination of native and foreign species, have never been compiled. Martin and Huber (19, 1927) treated all species of *Tremella* known at that time from Iowa.

Of the modern European mycologists, four should be considered in connection with their work with the Tremellales. Rea's treatment (26, 1922) of the genus *Tremella* is not especially notable. In addition to the usual subgeneric divisions, Foliaceous, Cerebriform, Crustaceous, and Tubercular, a fifth, characterized by a firm, hard nucleus, accommodates naematelias.

The taxonomic arrangement given by Bourdot and Galzin (4, 1927) is probably the best for the genus *Tremella*, the genus here including *Naematelia* as one of the four subdivisions, the other three being Mesenteriformes, Cerebriformes, and Tuberculiformes. The descriptions of the species are the result of careful research. Furthermore, the number of species considered is great enough to permit the application of the key and descriptions in countries other than France.

Killermann, in Engler and Prantl, 2 ed. Vol. 6 (1928), in his treatment of the genus follows Brefeld in including *Naematelia* and recognizing the separate genus *Craterocola*. He divides *Tremella* into six sections, Crustaceae, Cerebrinae, Mesenteriformes, Tuberculiformes, Claviformes, and *Phaeotremella*, the last division to accommodate Rea's dark-spored *Phaeotremella pseudo-foliacea*.

The standard work of Saccardo, even though it is only a combining of the results reported by other investigators, must be consulted frequently, but with caution.

Neuhoff (22, 1931) provides a critical key to the European species of *Tremella*, recognizing nineteen species and listing a number of additional species he regards as doubtful.

It will be observed in a review of the literature of the genus *Tremella* that the progress can be divided into rather definite steps; after the early confusion, when various foreign forms such as algae, imperfects, lichens, etc. were included, came, beginning with Persoon, the attempt at organization, excluding the most obviously foreign members, and finally with the Tulasnes and Brefeld, the use of basidial and spore measurements and descriptions to further delimit and organize the genus. While comparatively little intensive research has been done on *Tremella*, the genus has gradually been defined until today it possesses at least some degree of homogeneity. Now that classification is on a more fundamental basis than habit characters and texture afford, it appears that comparative stability within *Tremella* and related genera may soon be achieved. However, if the varying responses of particular species under different circumstances were to be observed, it is probable that many of the present specific boundaries would fall.

I have attempted, in the two discussions following, to make the work as accurate as possible and to base it, so far as facilities permitted, on objective standards. Colors describing the specimens are to be found in Ridgway's *Color Standards*. A camera lucida was used in making the drawings, all from material under the oil immersion lens and 10x ocular at the uniform magnification of 1600x. In selecting subjects for the drawings and measurements, an attempt was made to include the forms appearing most commonly within an individual specimen. Though it was not always possible to interpret all hymenial structures observed, drawings of them have been included for reference in future research. It is hoped that the history included in this introduction and the two discussions following may be of assistance to others attempting to meet the problems encountered in the genus *Tremella* and other related genera.

The work has been done in the mycological laboratory of the State University of Iowa under the direction of Professor G. W. Martin.

Tremella frondosa and *Tremella foliacea*

Both Coker and Lloyd express doubt whether *frondosa* and *foliacea* are distinct; I attempt to offer proof of their probable synonymy.

Tremella frondosa, a common species, has been described by a number of authors. All agree substantially as to habit of growth,

greater diversity of opinion occurring as to color. It is believed by all except Cooke that with age *frondosa* becomes darker, approaching black. Disagreement exists as to the color of the young stage, which is described as yellow or reddish yellow, fleshy brown, tawny and russet. Cooke describes it as yellow, growing pale. In material used for this study I found only one specimen which was not bearing spores; in color it ranged from cinnamon buff to honey yellow, which may or may not mean that the young stage is really lighter. I find little or no correlation between size of spores and color of specimen, and it is doubtful if there is much, if any, correlation between size of spores and size of fructification.

The spore measurements reported by unassociated workers are extremely inconsistent. Schroeter reports 5-7 μ , Bourdot and Galzin 7.5-10 x 7-9 μ , Martin and Huber 7-9 μ , Rea 8-10 μ , Coker 5.5-7.7 x 6-10.5 μ , Brefeld 10-17 μ^1 , Cooke 7-12 μ and Neuhoﬀ 7-10 x 7-9 μ . My own data, 3.5-7.5 x 5-10 μ , include the greater part of these figures. Saccardo and Cooke alone call the spores globose, Rea subglobose, Coker, and Martin and Huber, spherical to short-oval or broadly oval, Brefeld pyriform to globose, Bourdot and Galzin elliptical to subspherical, all of them apparently describing the same shape. I find the spores to be broadly oval to subglobose.

Few basidial measurements are given. Saccardo and Cooke describe the basidia as globose and 15 μ in diameter. Bourdot and Galzin record them as 14-18-24 x 11-12-18 μ , Neuhoﬀ as 16-20 (—24) x 12-18 μ . Coker calls the basidium pear-shaped, and ranging from 7.7-9.3 x 11-15 μ , with a few reaching 18 μ . My own measurements, 7.25-14.8 x 8.6-16 μ , include those of Coker, but the upper limits of those of Bourdot and Galzin have not been approached by several microns, though it is not doubted that such a divergence is easily possible.

Much misunderstanding exists concerning *Tremella foliacea*. Some authors recognize it as a species distinct from *Tremella frondosa*, some place it in a different genus, *Ulocolla*, and still others consider it synonymous with *T. frondosa*.

Tremella foliacea of Persoon's original description was a caespitose, concave (Peziza-like), undulate-plicate, cinnamon red form, crinkled at the base, each individual measuring one inch in diameter. He describes the substratum merely as rotting trunks. He considered *T. mesenteriformis* a synonym, citing in Bulliard's

* Neuhoﬀ (Bot. Archiv. 8:253, 1924) points out that Brefeld's measurements are always too large, due to errors in the scales he used.

Plate 406, figs. A and possibly a, which are very similar to the illustrations of *T. frondosa*.

The indefiniteness of the original description makes it impossible to say whether or not Fries has misinterpreted *T. foliacea*, as conceived by Persoon. Fries describes the species as dull rufous, lobes undulate, with furrows connate at the base, an autumnal form from one to two inches high and appearing on old fir, pine, and birch trunks. The importance of the concave character, given by Persoon, but not mentioned by Fries, can be determined only by examination of type specimens, if such exist.

In *T. frondosa*, his own species, Fries describes a very large caespitose form with gyrose undulate lobes and plicate base. As opposed to *T. foliacea*, it is firm, pallid yellow, and is reported on oak and beech. This would not of itself establish a new species.

With no basidial or spore characterization by Persoon or Fries, *T. foliacea* is subject to varied interpretations. The descriptions by Bourdot and Galzin and Rea agree in most points. To Bourdot and Galzin the species is brownish- or flesh-red, becoming lighter with age, undulate-sulcate, base plicate, 3-10 cm. in height and approaching roundness, the basidia nearly hyaline but becoming umber-brown and measuring $10-14 \times 13-16 \mu$, the spores ovoid, spherical, $6-9 \times 8.9-13 \mu$. Rea, however, records the spores as globose and $5-7 \mu$.

To Bourdot and Galzin *T. frondosa* is lighter, more yellowish than *T. foliacea*, slightly larger (5-12 cm.), on beech and holm oak. Neither spores (elliptical or subspherical, $7-9 \times 7.5-10 \mu$) nor basidia ($11-12-18 \times 14-18-24 \mu$) differ significantly. However, they do not record brown basidia for *T. frondosa*. Rea finds greater differences in height, *T. frondosa*, 10-12 cm., beginning at the upper limits of *T. foliacea*. This relatively greater size, 8-10 μ , is true also for the globose spores, which agree with those of Bourdot and Galzin.

It is highly probable that Bourdot and Galzin and Rea do not describe two species,—only different expressions of *T. frondosa*. I have found the brown basidia, as reported by Bourdot and Galzin, but I cannot, from data available, regard those specimens containing them as anything other than variations of *T. frondosa*.

Tremella foliacea, in the sense of Bresadola, as quoted by Coker, varies from hyaline-saccharine to fleshy-isabelline with umber violet, 4-8 cm. in height and width, spores globose and $7-10 \times 7-9$

μ , just beyond the figures by Rea, and the basidia 14-16 x 16-18 μ , beginning at the upper limits of measurements by Rea, and Bourdot and Galzin. He finds this species on *Larix* and *Abies*.

A new genus, *Ulocolla*, was established by Brefeld, on the basis of rod-shaped conidia produced at the ends of the germination tubes of the spores, to include *Exidia saccharina* and *Tremella foliacea*, with the latter possibly only a variety of the former. This *U. foliacea* Brefeld described as of the color of brown sugar, but darkening with age, lighter and sterile below, margins folded or the entire surface furrowed, the basidia and spores like those of an *exidia*, the spores being reniform and measuring 5-6 x 10-12 μ .

T. frondosa, to Brefeld, was a large tough-gelatinous tremella with distinct irregular ear-like lobes, weak red-yellow to chestnut brown in color, darkening with age, spores pear-shaped or globose and 10-12 μ , and found on both coniferous and deciduous wood. Obviously, Brefeld has two distinct species, but since the form he describes and figures as *Ulocolla foliacea* agrees in practically no respect either with Persoon's original description of *T. foliacea* or with that of Fries, one can hardly believe him justified in his synonymy. It seems also that he has interpreted *T. frondosa* too narrowly.

Cooke and Saccardo follow Brefeld in recognizing *U. foliacea*. Cooke, though agreeing essentially with Brefeld, describes the fructification as caespitose, 5-8 cm. broad, undulate, with plicate base, flesh or cinnamon, spores and conidia as described by Brefeld.

Cooke believes *T. frondosa* to be a large caespitose form reaching 15 cm. in diameter, with gyrose undulate surface, plicate base, color yellow growing pallid, not darker as Brefeld states, the spores globose and 7-12 μ , the globose basidia 15 μ .

Saccardo has merely combined the data of Brefeld and Cooke, except to note that *U. foliacea* occurs on fir, pine, and birch. He gives also for *T. frondosa* Schroeter's spore measurements, 5-7 μ , as well as those of Brefeld.

Gilbert describes *T. foliacea* as a form 2-5 cm. in height and 2-10 cm. in diameter, pinkish cinnamon, rarely deep brown, plicate base, with lobes so thick that a specimen can rarely be called foliaceous, spores and conidia as given by Brefeld. His figures, like his description, resemble very closely *Exidia recisa*. Gilbert's

description of *T. frondosa* is very indefinite. He finds it to be an extremely variable form, ranging in color from clear yellow to reddish brown, the lighter forms being the smaller. This species occurs most frequently on oak and may become 10-12 cm. in height and 25 cm. in length.

Lloyd suggests that possibly no distinction exists between *T. frondosa* and *T. foliacea*, except that the latter is supposed to be darker. He finds the hymenium the same, the spores hyaline, globose, usually 8 μ but some beyond 12 μ , and the basidia brown, varying greatly. Lloyd believes that *T. frondosa*, in the original sense, was only a large *T. foliacea*,—a commendable conception.

Coker, too, doubts, that a distinction can be made between *T. frondosa* and *T. foliacea*. However, his description of *T. frondosa* does not accommodate smaller and lighter forms previously segregated. His new species, *T. aspera*, includes forms distinguished from *T. frondosa* by larger spores (7-10 x 7-9 μ) and much larger basidia (16-18 x 14-16 μ), crumpled, thicker, less simple and less perfect lobes, more tender structure and darker color.

Neuhoff recognizes both species, agreeing essentially with the characters given for them by Bourdot and Galzin, except for the establishment of the variety *succina* to include those smaller, red-brown forms of *foliacea* found on coniferous wood and having brown basidia. He notes that the variety and the species are connected by transitional forms.

When one recognizes the importance of the study of basidia and spores, it becomes apparent how nearly impossible it is to distinguish between *T. foliacea* and *T. frondosa*, as described by the original authors, particularly with the great variation given for *T. frondosa*. Only by study of the type herbarium specimens can the distinction, if there is one, be established.

Taking into account the previous work on these two species and the data from specimens examined, *Tremella frondosa* may be characterized as follows:

Tremella frondosa, the largest species of the genus, may attain a height of nine centimeters or more; it is commonly elongated and slightly wider than high. The base of the fructification is laterally flattened and greatly elongated; the conspicuous furrows or plications, gyrose at times, are very close together at the base, becoming spread, branched, and less distinct as they progress upward,

disappearing in the lower half or fourth of the lobes arising from the base.

The lobes, frequently greatly contorted and fused at points with associated lobes, may be large, thin, undulate, with ruffled or only shallow scalloped margins, or there may be, even on the same fructification, coarse ridges which form a low, gyrose mass. The margins or even the entire free portions of the lobes are usually lighter than the body and certainly than the base of the fructification. This lighter portion, frequently cinnamon or clay color, may be as pale as cinnamon-buff or honey yellow. The base of the lobes, typically between Mars brown and Prout's brown, may be nearly umber, olivaceous brown, tawny, or russet. One specimen studied was a clear homogenous chestnut color. The base is always very nearly or quite black.

The basidia vary in shape from a somewhat compressed form, with the transition from hypobasidium to epibasidium abrupt (Fig. 8,d), to the comparatively slender oval or obovate basidium with a gradual transition from hypobasidium to epibasidium (Fig. 4,b). In size the hypobasidia range from $7.25\ \mu$ to $14.8\ \mu$ in width by $8.6\ \mu$ to $16\ \mu$ in length. The ratio of width to length, as estimated from averages of basidial measurements of each specimen, ranges from 1:1 to 1:1.4. Since there is much variation in size and outline of basidia, these characters cannot be used as diagnostic characters except in connection with other characters also. In the specimens studied the gradations between the basidial types, as well as in the size of spores, and the external characters, harmonize to the extent that one can do little other than call them all *Tremella frondosa*.

The spores are broadly oval to almost spherical or with one slightly flattened side (Plate I); the large mucro is displaced somewhat toward the flattened side. Though the spores show a remarkable range in size, the gradation is perfect. The width ranges from $3.5\ \mu$ to $7.5\ \mu$, the length from $5\ \mu$ to $10\ \mu$, the ratio from 1:1.1 to 1:1.7. Though the range is great, other characters of the individuals are such as to tie them all definitely into a single species. The spores, like the basidia, vary from hyaline to pale yellow, the contents usually evenly and finely granular, very seldom with large globules.

From the examined material labeled *T. foliacea* no conclusions can justly be drawn. Only fragments were available; they appear

much like the typical *frondosa*. The basidia, however, are outstanding in their cream and finally deep yellow or decided brown color. Frequently they are borne at the tips of much enlarged stalks (Fig. 12,a,b). They range from 8.5-15.5 μ in width by 10-19 μ in length. The yellow or brownish yellow spores range from 4.5-6.8 μ by 7-9 μ . The specimens studied for *T. foliacea* appear, from basidial and spore characters, to represent only a variation of *T. frondosa*.

At present it does not seem possible to prove that *T. foliacea* is only an expression,— environmental, age, or otherwise —, of *T. frondosa*. The descriptions of Persoon, Fries, Cooke, Bourdot and Galzin, Rea, Saccardo, Brefeld, Lloyd, Gilbert, Coker, Neuhoﬀ, Martin and Huber, and specimens from both Europe and America have been reviewed in the investigation of this point. Though I feel that they furnish less than absolute proof, I find much evidence for the synonymy of the two species.

Tremella lutescens and *Tremella mesenterica*

Among modern mycologists doubt has arisen that *Tremella lutescens* and *Tremella mesenterica* are distinct species. Coker recognizes only *T. lutescens*, but he presents no evidence in support of his decision. The purpose of this treatment is to offer proof of the synonymy of the two species.

As diagnostic characters habit, color, and texture have always been important in distinguishing between the two species. The season of appearance was emphasized by early students, but today it is disregarded; basidial and spore measurements are now considered very important.

In the sense of Fries and other very early mycologists, *Tremella mesenterica* Retz., is a simple, ascending, gyrose, plicate-undulate, smooth, tough, orange fructification appearing in winter and particularly in spring. Cooke later adds that the spores are shortly ellipsoid and 6-8 μ in diameter. Brefeld believes *T. mesenterica* a flatter, soft form with the lobes forming reticulate folds and the spores 10-12 μ .

The indefinite descriptions of earlier students have resulted in hopeless confusion among modern workers who have failed to observe the extreme variability in the form of the fructification. Bourdot and Galzin find *T. mesenterica* to be smaller and more nearly foliaceous than Rea indicates; otherwise their descriptions are essentially the same, regardless of the slight non-conformity

in basidial and spore measurements. Bourdot and Galzin find the spores to be ovoid or spherical, $7-10-12 \times 6-9-10 \mu$ and Rea broadly elliptical, $13-14 \times 7-8 \mu$, the basidia $15-20 \times 10-18 \mu$ and $15-20 \times 12-18 \mu$ respectively.

Among the recent American mycologists Gilbert, Lloyd, Martin and Huber, and Coker have worked on the species. Only in spore measurements does noticeable difference of opinion appear. Martin and Huber report the spores as measuring $12-14 \times 8-10 \mu$, included in the measurements of Bourdot and Galzin and Rea. Gilbert agrees with Cooke in spore measurements ($6-8 \mu$), while Lloyd finds the spores to be ovoid and $6 \times 8 \mu$. Only Lloyd reports basidial measurements, 14μ .

Persoon recognized the species *T. mesenterica*, but he described the new species *T. lutescens* to accommodate those forms resembling *T. mesenterica* except that they are paler, much softer, and appear in the autumn; Fries described it more fully as caespitose, with lobes crammed together and later connected, the fructification almost fluid in consistency, and whitish yellow in color.

Cooke, agreeing with previous conceptions as to habit, color, and texture, adds that the globose spores of *T. lutescens* measure $12-15 \mu$, four microns above the measurements for *T. mesenterica*. Brefeld, in disagreement with Cooke, considers *T. lutescens* the larger form. He adds also that the fructification when young is orange, but with age it becomes paler, even clear and crystalline. The basidial measurements given by Brefeld agree with those reported by Cooke, and begin at the upper limit of those of *T. mesenterica*.

T. lutescens in the sense of Bourdot and Galzin is slightly larger than *T. mesenterica*, definitely foliaceous, much paler—sulphur or very pale citron cream, almost hyaline when very moist, the spores possibly slightly longer, $10-11 (-22) \times 7-10 \mu$ (*T. mesenterica* $7-10-12 \times 6-9-10 \mu$) and the basidia $12-25 \times 16-18 \mu$ (*T. mesenterica* $15-20 \times 10-18 \mu$). Rea finds about the same difference in the two species except that *T. lutescens* is much smaller. The spore measurements are the same as those given by Bourdot and Galzin and little different from those given by Rea for *T. mesenterica*. The basidia range somewhat larger for *T. lutescens*, $19-25 \times 17-18 \mu$ (*T. mesenterica* $15-20 \times 12-18 \mu$); Bourdot and Galzin find a greater range of basidia, but the upper limits are the same as those of Rea.

Gilbert distinguishes between *T. mesenterica* and *T. lutescens* by the form and change in color, with *T. mesenterica* more brain-like and growing paler, and *T. lutescens* more mesentery-like, becoming more yellowish. Gilbert finds the spores of *T. lutescens* subglobose and much larger ($12-16\ \mu$) than those of *T. mesenterica* ($6-8\ \mu$ in diameter). Lloyd finds no difference in the two species except that one, *T. lutescens*, is very pale yellow; his spore measurements ($6 \times 8\ \mu$), like the basidia ($14\ \mu$), are not sufficiently extensive.

Martin and Huber have described *T. lutescens* as composed of hollow capitate lobes, rather firm, with the globose or broadly oval spores $6-9\ \mu$. Martin now believes the two species are only different expressions of the one, *T. lutescens*.

T. lutescens to Coker is a lobed mass with many of the larger lobes hollow, color pale to clear orange, firmly gelatinous, and with the spherical to short elliptic spores measuring $6.3-9 \times 7-13\ \mu$.

Neuhoff, like Bourdot and Galzin, finds the spores of *lutescens* ($10-16$ (-20) \times $8-12\ \mu$) to be slightly larger than those of *mesenterica* ($6-10 \times 7-10$ ($-12\ \mu$)); he reports the same relationship in respect to the basidia (*lutescens*, $15-20 \times 18-25\ \mu$ and *mesenterica*, $14-20 \times 12-18\ \mu$). Though Neuhoff's conception of the two species agrees in important particulars with that of Bourdot and Galzin, he differs in regarding *mesenterica* the larger and more deliquescent, less stable of the two species. He states that no conidia are produced in *lutescens*.

After an extensive, critical review of the literature and microscopic examination of specimens, I can recognize only one species, *Tremella lutescens*. The species is extremely variable. In color it ranges from practically hyaline through cream, baryta yellow, Naples yellow, buff yellow, warm buff, cinnamon buff, honey yellow, through the brilliant deep chrome, cadmium yellow, capucine yellow and orange, up to the intense Mars yellow. The most frequent coloration ranges from deep chrome or cadmium yellow to capucine yellow or orange.

The form assumed is dependent upon age and position on the limb. The fructification first appears as a tiny pale button, which grows into a thin lobe gathered at the base and often cupped; this stage is extended to form a linear, ribbon like series. As growth progresses folding appears in the upper part of the fructification. The form of the mature fructification is determined by position on substratum, those appearing dorsally being more or less cerebri-

form, and those appearing ventrally or laterally tending to grow upward, adhering to the bark, the free surface with the usual configurations, the adnate surface characterized by gyrose striations. In all forms there is a striate or sulcate area above the point of attachment beyond which the fructification quickly assumes a cerebriform-gyrose, or even more or less foliaceous character.

On account of this variation in the form the fructification assumes and the fact that the fungus begins fruiting quite early, it is obvious that measurements of habit are practically worthless. I have record of fruiting bodies from 3 mm. to 5.5 cm. in height, while a resupinate form spreads laterally 7 cm., and extends 3.5 cm. from point of origin directly out to the tip of the primary procumbent lobe.

Ordinarily the fructification is gelatinous, even deliquescent, but one finds specimens which apparently have been dried before their decline and, on being soaked, appear brittle and horny. Fresh conidial forms and declining specimens, which are commonly nearly or entirely hyaline, are extremely watery in consistency.

Tremella lutescens very early begins the production of conidia. The forked and branched conidiophore (Fig. 24) bears conidia which range from spherical and $2-3\ \mu$ in diameter to elongated forms with a length two or three times their width. It is difficult to draw a line between the larger conidia and certain other hymenial structures which are very confusing. One finds a great many globose surface bodies supported by an elongated inflated cell (Fig. 22c) with the greatest diameter nearly approaching or exceeding that of the superior structure; others show simply a heavy wall about the whole with no surface constriction, yet a distinct dividing line exists (Fig. 18f). Again, one finds a much inflated cell supporting the smaller globose end cell (Fig. 22e). A branch may bear two spore-like bodies on opposite points (Fig. 21c). Chains of somewhat enlarged and rather elongated heavy-walled cells (Fig. 17b), sometimes with clamp connections, are frequently seen. There are also large bodies approaching the size of basidia (Fig. 22f), commonly hyaline, though sometimes containing protoplasm that has occasionally divided longitudinally (Fig. 22g), much as do basidia.

I have no suggestion as to the significance of these hymenial monstrosities. In them one can find a reasonably convincing trans-

ition from conidia to basidia, and this may be the proper interpretation, especially since they appear, for the most part, in an area intermediate between the conidial and the basidial regions and amidst the basidia.

Within a single hymenium one finds much variation in shape and size of basidia. There is a perfect gradation from the somewhat elongate basidia (Fig. 16a) with a ratio of 1:1.4 (of average width to length) to those slightly compressed (Fig. 17a) with a ratio of 1:0.89. In width they range from 12 to 27 μ and in length from 12 to 18 μ . However, the variation as gathered from the averages of the individual specimens would be 13 to 21.5 μ for width and 15.6 to 23 μ for length. In color they vary from hyaline to distinctly yellow.

The spores (Plates II, III) vary from subspherical to obovate, broadly elliptical, and ovate. In width they range from 6 μ to 12.5 μ and in length from 8.5 μ to 15.7 μ . Expressed in averages the range would be from 6.7 to 10.5 μ in width by 9 to 13.2 μ in length, which probably includes the more frequent sizes. In color the spores may be hyaline, light cream, or rather a decided yellow.

Paraffin sections (Fig. 27) show that the cavities within the fructification are produced by lobes falling over. Where a lobe touches another part of the fructification coalescence occurs to a certain extent, yet leaving an appreciable open area which usually displays at least some of the peculiar hymenial structures previously described. However, it appears probable that some hollowness may result in older parts of the fructification from the breaking down of interior hyphae.

I have found no justification for retaining the two species. After a study of the forms assumed at different stages of development, I find it almost certain that what most authors refer to as *T. lutescens* is either a young or late form of *T. mesenterica*, as ordinarily described, or can be explained as a response to environmental conditions. No true distinctions can be established on relative size, spores, and basidia, for no sufficient agreement exists. I have found in a single collection all variations from the pale young forms through the orange cerebriform or prone lateral forms, to the soft, pallid deliquescent stage. Fries indicates that *Tremella lutescens* may be described as foliaceous and *T. mesenterica* cerebriform, but I have seen specimens which were partially foliaceous, some areas remaining cerebriform. Furthermore, with-

in a single specimen I have found a range of spore and basidial measurements sufficient to indicate both *T. lutescens* and *T. mesenterica* as reported.

After a microscopic examination of a great number of specimens of a single species, it becomes apparent that the seeming disagreement in spore and basidial measurements reported is not to be taken too seriously. The spores are to be considered somewhat longer than broad,—shortly ellipsoid, ovoid, occasionally spherical. Some authors report only one dimension. Considering the shorter dimension one finds most authors agree substantially. Neither in the basidial data is appreciable disagreement reported; most seeming discrepancies are practically negligible.

With the results of this study in mind, I cannot consider substantial the differences between *T. lutescens* and *T. mesenterica*, as described by Fries. Consequently I am combining the two species. Since the name *lutescens* appears first in Fries *Systema Mycologicum*, a pedantic application of the International Rules of Nomenclature requires that this name be used. However, in modern literature it is the descriptions of *T. mesenterica* that apply to the brilliant orange, usually cerebriform phase most commonly collected; hence, much confusion would be prevented by the retention of this name. Furthermore, it seems indeed unfortunate to apply to this tremella, brilliant and substantial the greater part of its existence, an utterly inappropriate name, which has always been associated with a pale, washed-out, yellow, deliquescent form, which proves to be the declining or unusual environmental expression of the species. However, if the taxonomic system is to be relieved of its present confusion, a strict following of the International Rules is necessary, even though in some cases, as this, such strictness may bring about inappropriate naming.

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PLATE I

TREMELLA FRONDOSA AND T. FOLIACEA

All figures of microscopic details drawn with camera lucida at a magnification of 1600 diameters, and reduced to 800 diameters in reproduction.

- | | |
|----------------------------|--|
| Fig. 1. G. W. M. 704. | a. basidium; b. spores. |
| Fig. 2. G. W. M. 154. | a.-b. basidia; c. spores. |
| Fig. 3. L. 61. | a. c. basidia; d. spores. |
| Fig. 4. L. 62. | a.-b. basidia; c. spores. |
| Fig. 5. G. W. M. 154. | a. basidia; b. spores. |
| Fig. 6. L. 67. | a.-b. basidia; c. tip of epibasidium; d. spores. |
| Fig. 7. L. 65. | a. basidium; b. spores. |
| Fig. 8. M. B. G. H. 59652 | a.-e. basidia; f. tip of epibasidium with young spore attached to lateral sterigma; g. spores. |
| Fig. 9. G. W. M. 159. | a.-b. basidia; c. spores. |
| Fig. 10. L. 60 | spores. |
| Fig. 11. M. B. G. H. 60496 | a.-c. basidia; d. spores. |
| Fig. 12. G. W. M. 148. | a.-b. basidia (brown) raised above the hymenial layer on stalks; c.-d. basidia of usual type; e. chlamydospore (?) f. spores. |
| Fig. 13. L. 44. | a.-b. basidia; c. swollen anastomosing hyphae tipped by basidia-like cells; d. peculiar dark hymenial structure which by division shows a relationship to the basidia. |

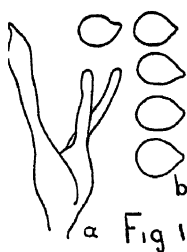


Fig 1

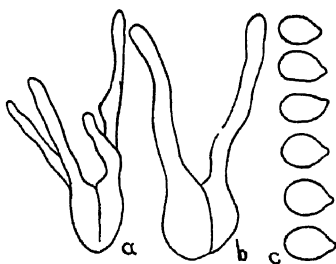


Fig 2

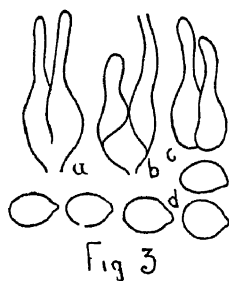


Fig 3

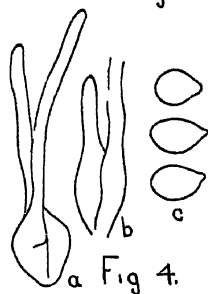


Fig 4

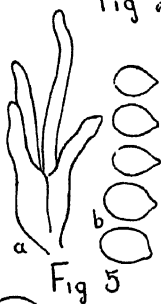


Fig 5



Fig 6

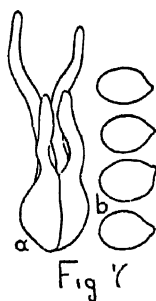


Fig 7

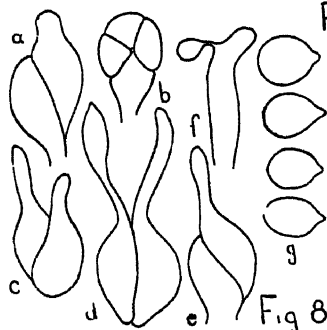


Fig 8

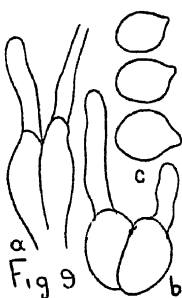


Fig 9

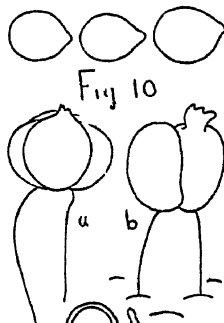


Fig 10

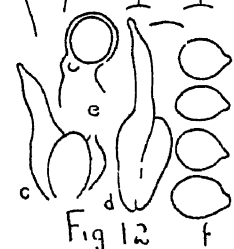


Fig 12

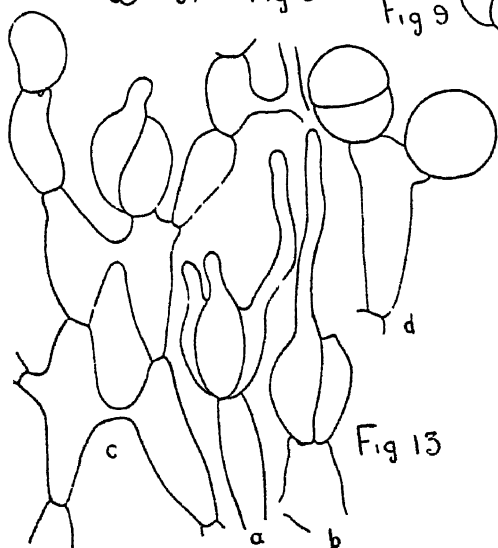


Fig 13

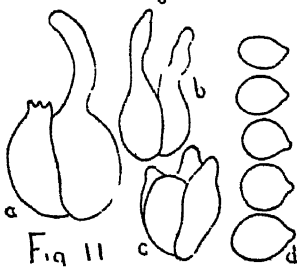


Fig 11

PLATE II

TREMELLA LUTESCENS

All figures of microscopic details drawn with camera lucida at a magnification of 1600 diameters, and reduced to 800 diameters in reproduction.

- | | | |
|----------|--------------------|--|
| Fig. 14. | M. B. G. H. 57664. | a-b. basidia; c. spores. |
| Fig. 15. | M. B. G. H. 60627. | a-b. basidia; c. peculiar hymenial structure; d. spore. |
| Fig. 16. | L. 71 | a. basidium; b. spores. |
| Fig. 17. | M. B. G. H. 59655. | a. basidium; b. heavy-walled filament in the hymenium; c. spores. |
| Fig. 18. | Dav. 215. | a. basidium; b-f. hymenial structures; g. spore germinating by conidia; h. spores. |
| Fig. 19. | M. B. G. H. 5362. | a. filament in the hymenium; b. basidium; c. spore. |
| Fig. 20. | Dav. 648. | a. basidium with surrounding conidia-like bodies; b. basidium; c. spores. |
| Fig. 21. | M. B. G. H. 57685. | a. oidia; b-c. hymenial structures; d. spores. |

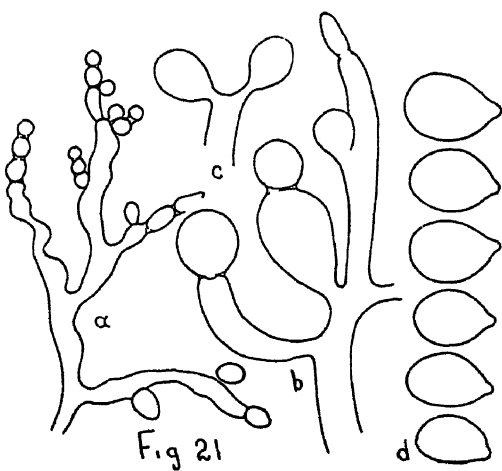
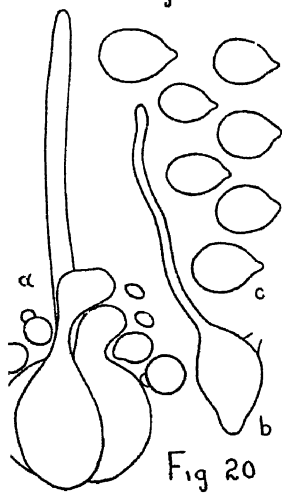
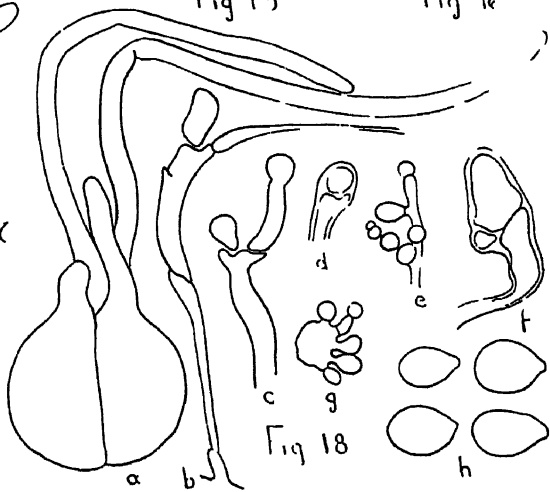
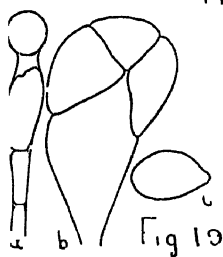
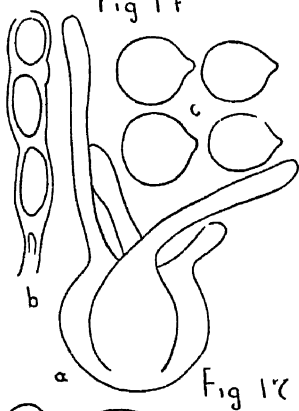
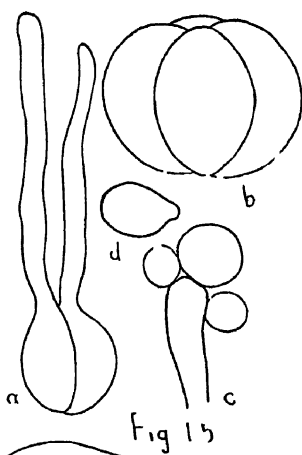
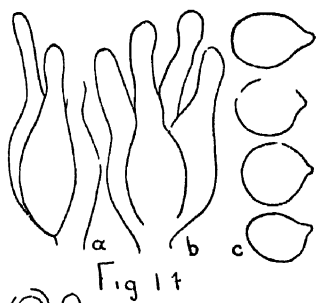


PLATE III

TREMELLA LUTESCENS

All figures of microscopic details drawn with camera lucida at a magnification of 1600 diameters, and reduced to 800 diameters in reproduction.

- Fig. 22. M. B. G. H. 5355. a-b. basidia; c-e, h-j., swollen hymenial structures; f. vesicular hymenial structure; g. vesicular structure in which contents have divided; k. thick-walled hymenial filament; l-m. spores.
- Fig. 23. L. 63. a-b. basidia; c. conidiophore and conidia; d. spores.
- Fig. 24. G. W. M. 395 conidiophore and conidia.
- Fig. 25. M. B. G. H. 19435. conidiophore and conidia.
- Fig. 26. M. B. G. H. 56591. a. vesicular hymenial structure; b. heavy-walled hymenial filament; c. spores.
- Fig. 27. Section of mature fructification:
conidial area stippled;
vesicular area in lines;
basidia present, lines and circles.

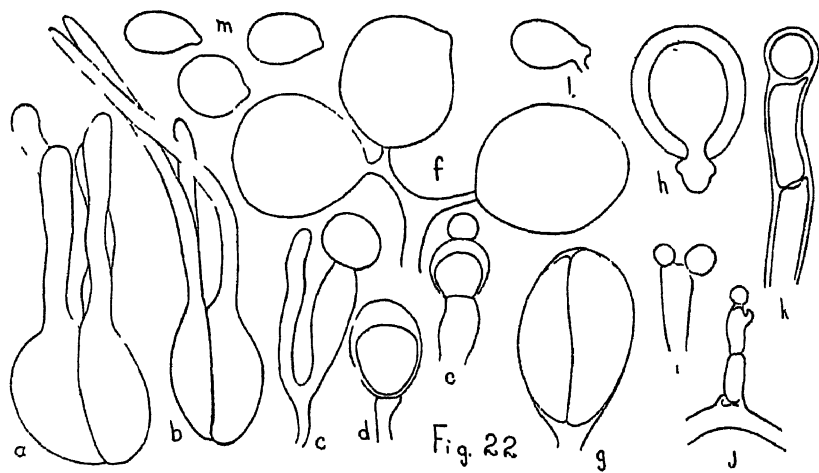


Fig. 22

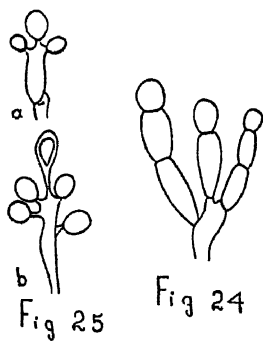


Fig. 24

Fig. 25

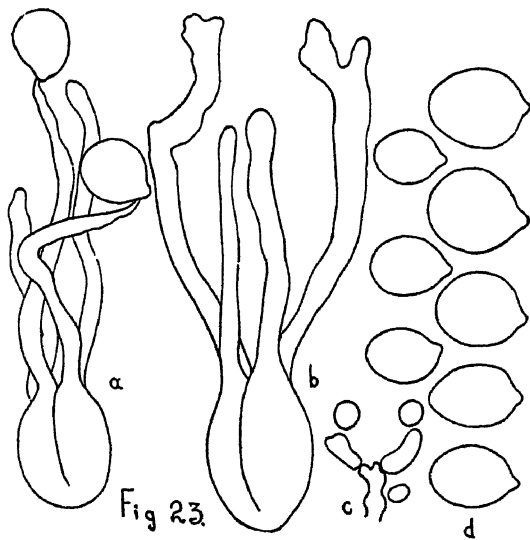


Fig. 23

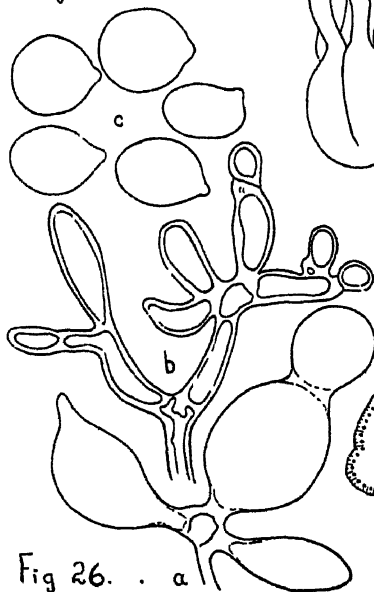


Fig. 26

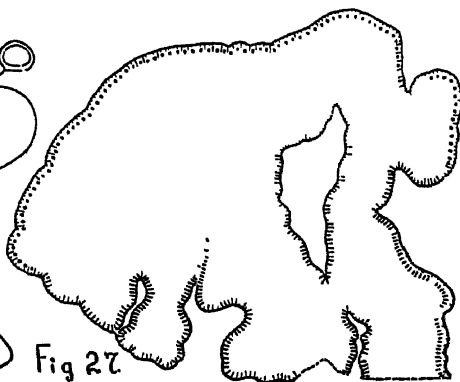


Fig. 27

UNIVERSITY OF IOWA STUDIES

STUDIES IN NATURAL HISTORY

Volume XV

Number 2

The Stratigraphy and Paleontology of the Gilmore City Formation of Iowa

by

LOWELL R. LAUDON

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HENRY FREDERICK WICKHAM, Editor

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INTRODUCTION

LOCATION OF THE AREA

[illegible]

Figure 1. Known areas of exposure of the Gilmore City and Alden formations in Iowa.

boldt County along the Des Moines River valley and in the adjacent highland to the south of the river between Humboldt and Gilmore City. The best exposures of the formation are in the Gilmore City quarries which are located in the southwest portion of Sec. 25, T. 92 N., R. 31 W., in Pocahontas County. The other exposures in Pocahontas County are located within a few square miles in the immediate vicinity of Gilmore City.

The second locality in which this formation is exposed is in Hardin County along the Iowa River in the vicinity of Alden. In this area the exposures are limited to about five miles of the river valley.

PREVIOUS WORK

The first work in the area was done in 1870 by White¹ for the Iowa Geological Survey in which he reports "subcarboniferous" limestone of Kinderhook age along the Des Moines River near Humboldt. The St. Louis limestone which is also exposed in this region was considered by White to be of Kinderhook age. The exposures in Pocahontas County at the site of the present quarries at Gilmore City also were visited, and it was predicted that at some future time the rock would be an important source of lime.

In 1899 T. H. Macbride² limited the areal extent of the Kinderhook rocks in this region by recognizing that they were overlain by St. Louis limestone. In this report, for the first time fossils were listed from the oölitic limestone at Humboldt. A fauna was collected from an exposure in the southern portion of the city of Humboldt which, after conference with Weller, Macbride referred to the St. Louis limestone. In the light of present studies, it has become apparent to the writer that this material represents a zone near the upper portion of the Gilmore City formation.

To Sardeson³ of Minneapolis should go the credit for completing the first detailed piece of work in the area. Sardeson recognized that the fauna of the Humboldt oölite is not exactly like the fauna of the Kinderhook of the Mississippi Valley, and he arrived at the conclusion that it might represent a western invasion. Sardeson

¹ White, C. A., Report on the geological survey of the State of Iowa: Iowa Geol. Survey, vol. 1, p. 218, 1870.

² Macbride, T. H., Geology of Humboldt County: Iowa Geol. Survey, vol. 9, p. 123, 1899.

³ Sardeson, F. W., Carboniferous Formations of Humboldt, Iowa: American Geologist, vol. 30, p. 300, 1902.

remained until very recently the only worker who realized that this fauna was not the typical Kinderhookian fauna of the Upper Mississippi Valley. However he apparently followed Macbride and Weller in interpreting the fauna of the St. Louis limestone, when he collected fossils from the exposure of supposed St. Louis limestone in Mr. Peckham's quarry in the southeastern portion of the city of Humboldt and referred them to the St. Louis limestone.

In the report on the Geology of Pocahontas County, Macbride⁴ mentioned that Kinderhook limestone is overlain by the St. Louis limestone in the eastern portion of Pocahontas County. At the present time no exposures of the St. Louis limestone are known in Pocahontas County.

In 1906 Beyer and Williams⁵ refer to the St. Louis limestone overlying the Kinderhook limestones in Humboldt and Pocahontas counties. Many of the exposures of limestone considered to be of St. Louis age in their report are now known to belong to the upper zones of the Gilmore City formation.

In the report on the Mississippian of Iowa by Van Tuyl⁶ the possibility of correlating the Humboldt oölite with the Alden limestone of Hardin County was suggested. The fauna of the Humboldt oölite was considered to be Kinderhook in age but no direct correlations were made with the type Kinderhook section of the Mississippi Valley.

In 1932 the writer⁷ correlated the Gilmore City limestone with the Alden limestone of Hardin County and removed the Gilmore City formation from the Kinderhook on the basis of the sharp unconformity which separates the Alden limestone from the underlying Kinderhook beds near Iowa Falls.

In the present report the Gilmore City limestone is regarded as a Kinderhook formation lying unconformably on the youngest member of the Hampton formation of Iowa and beneath the earliest strata referable to the Osage series.

⁴ Macbride, T. H., *Geology of Pocahontas County*: Iowa Geol. Survey, vol. 15, p. 227, 1905.

⁵ Beyer, S. W., and Williams, I. A., *Limestone Quarries of Iowa*: Iowa Geol. Survey, vol. 17, p. 425, 1906.

⁶ Van Tuyl, F. M., *Mississippian of Iowa*: Iowa Geol. Survey, vol. 30, p. 99, 1922.

⁷ Laudon, L. R., *Stratigraphy of the Kinderhook of Iowa*: Iowa Geol. Survey, vol. 35, p. 417, 1932.

TOPOGRAPHY AND DRAINAGE

The area of exposure of the Gilmore City formation lies entirely within the drift plain of the Wisconsin Glacier. The area around Gilmore City is a rolling plain with little relief. In the immediate vicinity of Gilmore City the drift mantle, overlying the bed rock, is very thin and at the site of the two main quarries at Gilmore City the bed rock is essentially at the surface.

The Wisconsin drift plain of this area is cut by two branches of the Des Moines River. These rivers have cut shallow, comparatively wide, valleys in the drift and throughout the distance from Bradgate to Humboldt, the west fork of the river flows essentially on the upper surface of the Gilmore City formation. From Rutland to Humboldt the river has cut a shallow valley into the upper portion of the formation, producing low cliffs on the outside of the meanders. South and east of Humboldt the only exposures visible on the bank of the river are of later age.

GENERAL GEOLOGY

The formations exposed in the Gilmore City area are confined to two geologic periods. The Gilmore City formation is the oldest horizon exposed in the region and consists almost entirely of gray, white, or blue cross-bedded limestone. It is unconformably overlain by the St. Louis limestone, and the contact of the two is usually leached. The St. Louis formation consists of brown dolomite at the base followed by gray brecciated limestone. Occasional lenses of shaly blue or green sandstone are to be found in the lower portion.

The St. Louis limestone is unconformably overlain by shales and sandstones of Pennsylvanian age. Several exposures showing the contact of the two formations may be seen along the Des Moines River valley near Humboldt.

ACKNOWLEDGMENTS

To one great student in the field of crinoidal structure, the writer is forever indebted. Almost all of the spare time throughout one complete year was spent by the late Professor A. O. Thomas of the State University of Iowa in study and in preparation for study of many of the specimens which are figured in this report. The writer owes almost all of his training in the field of crinoidal structure to Professor Thomas. To those who knew Dr. Thomas

COMPOSITE MISSISSIPPIAN SECTION OF IOWA

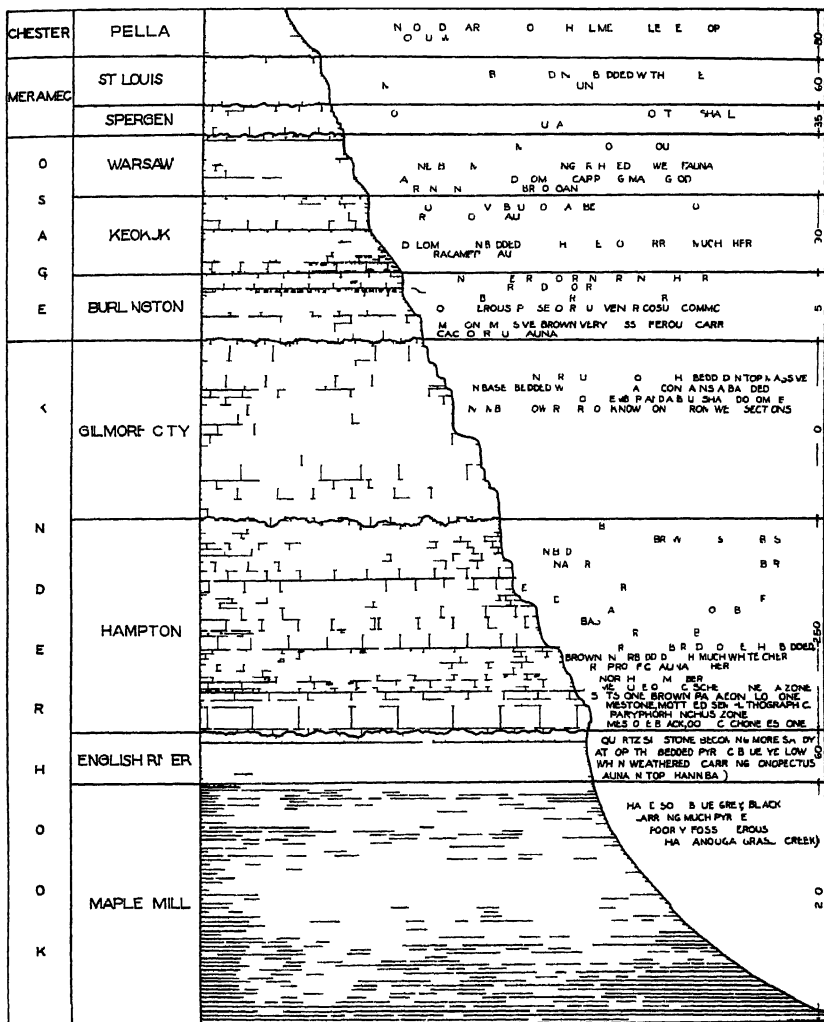


Figure 2 Composite Mississippian section of Iowa

and knew of his intense interest in crinoids, this report will mean more

Mr. C. T. Kohn, paleontologist and geologic artist for the Mid-Continent Oil Corporation of Tulsa, drew all of the illustrations which appear in the plates of this report. Through two years of study Mr. Kohn has become an excellent student of crinoidal struc-

ture, and he has spent as much time in the preparation of this report as the author. Without the aid of an artist, the task of preparing illustrations of crinoidal material is extremely difficult. The value of the assistance of a paleontologist who is a skilled artist can not be overestimated.

Every possible assistance and privilege has been extended by Dr. B. H. Beane of LeGrand, Iowa. His entire collection of thousands of specimens of LeGrand crinoids has been made available for study.

Dr. A. K. Miller of the State University of Iowa has contributed valuable suggestions which have been incorporated into the manuscript.

The type specimens of crinoids from the Madison limestone of Montana, now housed in the collections of the University of Cincinnati, have been made available for study by Dr. M. S. Chappars of that institution.

Type specimens and all other crinoidal material collected from the Madison limestone of the west in the collections of the University of Montana have been made available for study by Dr. C. F. Deiss of the University of Montana.

The writer wishes to acknowledge the services of Mr. B. H. Mills of Tulsa, who aided in the drawing of geologic sections.

Special mention must be made of the work of "The Howards," commercial photographers of Tulsa. Without the excellent services of this studio, the production of plates would have been much more difficult.

THE GILMORE CITY FORMATION

The best exposures of the Gilmore City formation are located in the quarries of the Northwestern States Portland Cement Company and the Pennsylvania Dixie Cement Company about one mile northwest of Gilmore City. At the present time the thickest section consisting of 57 feet of limestone is exposed in the northwestern corner of the Pennsylvania Dixie Quarry and is here designated as the type section of the formation. The uppermost beds of the formation are missing from this section, due to erosion, but are well exposed along the Des Moines River in the vicinity of Humboldt. The lower portion of the formation is not exposed in Iowa and is known only from well borings.

TYPE SECTION GILMORE CITY FORMATION

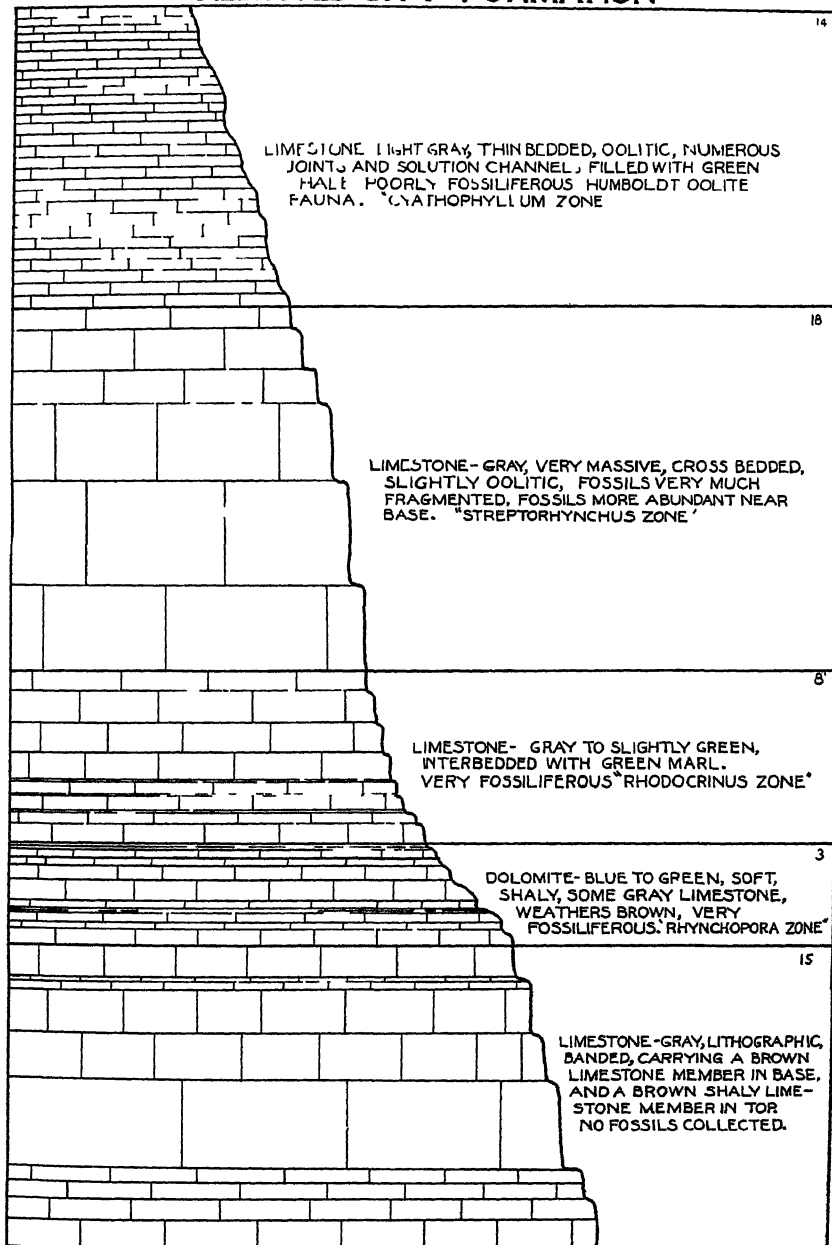


Figure 3. Type section of the Gilmore City formation.

LITHOLOGIC CHARACTER

The formation as exposed in the Gilmore City quarries has been divided into definite lithologic and faunal zones to aid in locating faunal horizons within the formation and to aid in correlation with other sections within the region.

The Gilmore City formation is essentially a pure white soft often oölitic limestone. It varies from very massive to thin beds and is often cross-bedded. It is usually bedded with soft green shale. Minor amounts of blue dolomite occur at definite horizons. In general this formation is one of the most consistently white limestones of Iowa. It may be readily identified in well sections because of its distinctive lithology.

The following zones are established as divisions of the type section in the northwest corner of the Pennsylvania Dixie Quarry at Gilmore City. They are based mainly on lithology and fauna.

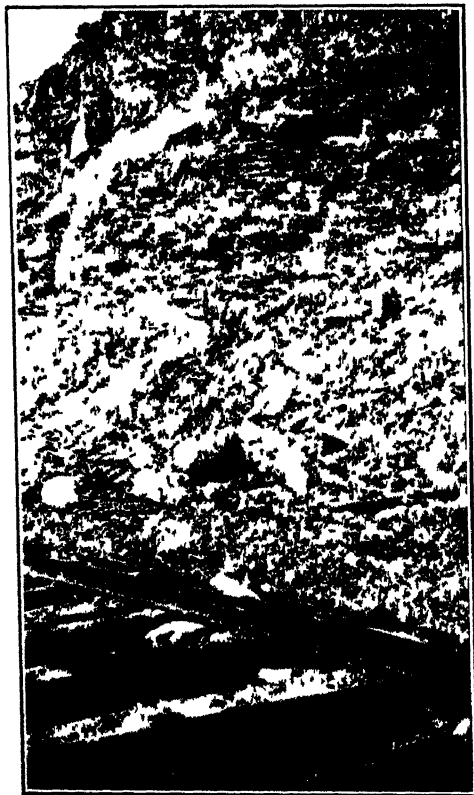


Figure 4. Photograph of the type section of the Gilmore City formation.

Lowermost Zone (Unnamed): The Pennsylvania Dixie Company opened a lower horizon in the quarry late in the summer of 1931 which has not as yet been well studied. At the present time no fossils have been collected from this horizon, and because of this fact no name is proposed for it. This zone may be readily distinguished from others in the formation of its distinctive lithology. The major portion consists of delicately banded gray semi-lithographic limestone filled with large masses of calcite. Banding in the limestone is in some cases parallel to the bedding and in others definitely concentric. The basal ledge of the zone consists of brown limestone and the upper portion of soft brown dolomitic limestone.

The Rhynchopora Zone: The *Rhynchopora* zone is named for the fossil brachiopod *Rhynchopora coopercensis* which occurs very abundantly throughout the horizon. This form is not restricted to this one zone in the formation and is used only because it is present in large numbers in the zone.

The *Rhynchopora* zone consists of about 5 feet of blue soft marly dolomite. There are usually three portions to the zone: a lower very soft dark blue layer, a central hard gray limestone layer, and an upper lighter blue dolomitic layer. This upper blue layer is usually harder, thinner bedded, and carries more lime than the lower blue layer. This zone would make an excellent datum plane in the formation because of its distinctive color and lithology. It is exposed only in the quarries at Gilmore City.

The Rhodocrinus Zone: The *Rhodocrinus* zone is named for the variety of species of *Rhodocrinus* which occur abundantly throughout the entire horizon. The genus *Rhodocrinus* is not confined to this horizon, but it is rare in others. This zone might well have been named for a number of forms which occur in the erinoid fauna; *Rhodocrinus* however was chosen because of its abundance.

Lithologically the *Rhodocrinus* zone consists of hard gray limestone ledges which are often slightly oölitic. The beds, which average about one foot in thickness, are bedded with soft green marl. It is rather sharply defined beneath by the soft blue dolomitic layer. It grades into the overlying *Streptorhynchus* zone and may be differentiated from it only by the fact that the *Streptorhynchus* zone is more massive. The *Rhodocrinus* zone is about 8 feet in thickness.

About 95 per cent of the erinoids which have been taken from this formation were found within the *Rhodocrinus* zone. The lime-

stone surfaces upon which these crinoids were found were very uneven and filled with pockets of green marl. The crinoids whenever found were occupying depressions on the surface of the limestone and were protected by soft green marl. The preservation of the crinoids has apparently been due to "clouds" of silt that settled occasionally in the limestone depositing sea. They were apparently buried rapidly with very little disturbance due to the action of the waves and currents.

The Streptorhynchus Zone: This zone is named for the fossil brachiopod *Streptorhynchus ruginosa* which occurs fairly abundantly in the zone. The zone as a whole is not particularly fossiliferous. Life was prolific at the time of deposition of the sediments in this zone but the action of the waves and currents more or less completely fragmented the forms. *Streptorhynchus* occurs more commonly at this horizon in the formation than at any other.

The zone consists of 18 feet of very massive, slightly oölitic, cross-bedded limestone. The lower ledges vary between three and five feet in thickness. In general the zone becomes progressively more thin-bedded towards the upper portion. It also becomes less cross-bedded and less fossiliferous towards the upper portion. It is bounded below by the comparatively thin-bedded *Rhodocrinus* zone. It grades into the overlying *Cyathophyllum* zone and may be distinguished from it only with difficulty. The *Cyathophyllum* zone is thinner bedded and much less fossiliferous.

The Cyathophyllum Zone: This zone is named for a long slender species of *Cyathophyllum* which occurs consistently throughout the zone. In one particular bed near the middle of the zone it occurs in almost reef-like numbers.

This zone consists of about 20 feet of gray, thin-bedded, pure, oölitic limestone. The material is always irregularly bedded and usually much fractured and jointed. Along the Des Moines River from Rutland to Humboldt the limestone appears in a much less fractured form. Where weathering has not softened this limestone, it is very difficult to obtain fossils.

THICKNESS OF THE FORMATION

The entire thickness of the Gilmore City formation is not exposed in Iowa. The maximum section of approximately 57 feet is exposed near the northwest end of the Pennsylvania Dixie Quarry at Gilmore City. The maximum thickness of exposed sections in the

vicinity of Humboldt along the Des Moines River is never over 20 feet.

The exposure of the Alden limestone in the quarry at Alden on the Iowa River shows only 32 feet of limestone. Core drilling in this region however has shown that the formation reaches a thickness of over 100 feet.

Greater thickness of the Gilmore City formation is found to the south and west from the type section at Gilmore City in the deep well sections of Iowa. At Fort Dodge the formation is 220 feet in thickness. At Gowrie 280 feet of strata may be assigned to the formation. The following thicknesses have been determined by a reinterpretation of the well logs of Norton²: Webster City 110 feet, Denison 280 feet, Dunlap 270 feet, Logan 280 feet, California 254 feet, Audubon 285 feet, and Glenwood 105 feet.

It is not possible to state at the present time whether the variations in thickness of the formation are due mainly to the unconformity which appears at the base of the formation or to an erosion surface at the top.

STRATIGRAPHIC RELATIONS

The contact of the Gilmore City formation with the underlying Hampton formation is not exposed in the vicinity of Gilmore City. The only known exposure of this contact in Iowa is in the Iowa River valley near Alden. At this point the Alden limestone which is a correlative of the Gilmore City formation rests on the sharply eroded, leached surface of the Iowa Falls member of the Hampton formation. Three miles farther to the west in the quarries at Alden core drilling has shown that the Alden limestone rests on the lithographic limestone zone in the upper portion of the Eagle City member of the Hampton formation. This relation suggests that the Alden limestone was deposited in a valley which had been eroded into the upper surface of the Hampton formation. Too little is known of the subsurface stratigraphy in Iowa at the present time to trace this unconformable surface far to the west with certainty.

The Gilmore City formation is unconformably overlain by the St. Louis limestone in the Gilmore City area. The St. Louis limestone is not present in either of the quarries at Gilmore City but may be seen in numerous exposures along the Des Moines River

² Norton, W. H., *Underground Water Resources of Iowa*: Iowa Geol. Survey, vol. 21, 1913, vol. 33, 1930.

from Rutland to Humboldt. The St. Louis formation retains its usual wavy, thin-bedded appearance in this region and may be easily recognized by its lithological character alone. The basal beds are usually brown dolomite and are followed by typical gray, brecciated, sub-lithographic limestone. A good exposure of the unconformable contact may be seen about 200 feet downstream from the dam at Rutland on the north bank of the river. Other good exposures of the contact may be seen at intervals throughout the distance from Rutland to Humboldt. A very good exposure showing this contact may be seen in an old abandoned quarry in the extreme southern portion of the city of Humboldt.

The lower three zones of the Gilmore City formation are exposed only in the quarries at Gilmore City. The *Streptorhynchus* zone is exposed in one or two abandoned quarries in the immediate vicinity of Gilmore City. Most of the exposures in the region consist of a portion of the *Cyathophyllum* zone. Numerous exposures of this zone may be seen in sink holes in both Humboldt and Pocahontas counties. All of the exposures along the Des Moines River from Bradgate to Humboldt represent some part of this zone.

SUBSURFACE STRATIGRAPHY

The Gilmore City formation may be traced in deep well sections very successfully because of its distinctive lithology. It is a pure soft white often oölitic limestone which usually carries very little chert. The Osage formations which would naturally overlie this formation are everywhere characterized by great amounts of chert. The St. Louis formation may be easily recognized because it consists of alternating beds of dolomite, limestone, and shale with considerable chert. The underlying Kinderhook formations are dolomitic or shaly in their nature.

The following data have been taken from Norton's⁹ interpretations of the deep well sections of Iowa. The well cuttings have not been seen by the author and the following interpretations are based entirely on the original descriptions of Norton.

Deep wells at Fort Dodge in Webster County show a thickness of 210 feet of material which may be referred to the Gilmore City formation. The Gilmore City is overlain by the St. Louis lime-

⁹ Norton, W. H., *Underground Water Resources of Iowa*: Iowa Geol. Survey, vol. 21, 1913, vol. 33, 1930.

stone and underlain by the cherty dolomites of the Hampton formation. The upper contact of the formation was reached at 200 feet and the lower contact at 420 feet. The lowermost shaly material in the Mississippian section as designated by Norton in this well should probably be referred to the Sheffield formation.

At Gowrie in the southern portion of Webster County the thickness of the Gilmore City has increased to 250 feet. It is overlain by the St. Louis limestone and underlain by 90 feet of material which probably should be referred to the Hampton formation. The Hampton formation gradually undergoes changes toward the south and becomes more sandy and shaly.

The Gilmore City formation is 280 feet in thickness in the deep well at Denison in Crawford County and is overlain by a very thick section of the St. Louis limestone. It is questionable whether or not the Hampton formation is present at all in this section. The Gilmore City-St. Louis contact is found at a depth of 490 feet.

At Audubon in Audubon County the Gilmore City formation is 285 feet in thickness. Nearly 100 feet of strata representing the Hampton formation occur below the Gilmore City formation. At least 50 feet of Chattanooga shale is present at the base of the Mississippian section in this well. The upper contact of the Gilmore City is found at 660 feet and the lower contact is located at 945 feet.

At Dunlap in Harrison County the formation is 265 feet in thickness. At Logan in the same county it is 280 feet in thickness. At California, also in the same county, about 254 feet of limestone of Gilmore City age are present. The descriptions of the soft white oölitic limestone in these wells make its identity almost certain.

At Holstein in Ida County the St. Louis limestone is underlain by 60 feet of limestone and dolomite which should probably be referred to the Gilmore City formation. At Sioux City the St. Louis is again underlain by 60 feet of limestone which seems certainly to represent a portion of the Gilmore City formation. It is very apparent that the Gilmore City formation thins rapidly to the north.

A thickness of 140 feet is assigned to the Gilmore City formation in the well at Rippey in Greene County. It is overlain by 100 feet of St. Louis limestone and is underlain by 140 feet of beds which may be referred to the Kinderhook. The upper contact is located at 430 feet and the lower contact at 570 feet.

In the Stuart well in southern Guthrie County 100 feet of lime-

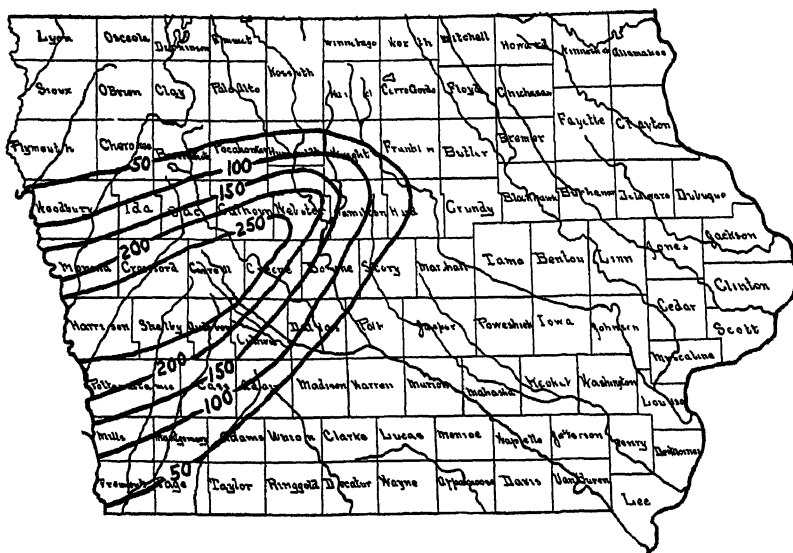


Figure 5. Map showing the thickness of the Gilmore City formation in western Iowa.

stone may be referred to the Gilmore City formation. It is overlain by St. Louis limestone and underlain by Hampton. The base of the Mississippian section is marked by the Chattanooga black shale.

At Atlantic in Cass County it is quite difficult to separate the Gilmore City formation from the overlying beds of the Osage series. The formations have been logged showing a considerable amount of chert throughout the entire Mississippian section. The presence of much chert in the Gilmore City formation is unusual. It seems probable however that much of this chert might have come from the overlying Osage formations. A green shale bed between the Gilmore City and the chert horizons probably represents the St. Joe formation of Missouri, Kansas, and Oklahoma. The Gilmore City appears to be about 170 feet in thickness in this well.

At Council Bluffs and Omaha, wells have been drilled which show nearly 200 feet of limestone underneath the green shale horizon at the base of the Osage series. Above the green shale horizon some 200 feet of cherty limestone has been logged which represents the Osage-Boone series of Missouri, Oklahoma, and Kansas.

South of Omaha the Gilmore City formation thins quite rapidly so that at Glenwood it is represented by only 105 feet of strata.

It is again overlain by green shale of the basal Osage and underlain by Kinderhook shales, the lower portion of which are probably Chattanooga in age. The upper contact of the Gilmore City formation is located at 1668 feet and the lower contact at 1765 feet.

In the deep well at the city of Bedford in Taylor County the Osage series is represented by over 300 feet of cherty limestone. At the base of this cherty limestone, a bed of soft white oölitic limestone has been logged. This oölitic limestone is underlain by the Chattanooga black shale. It may be that this thin layer represents a southern extension of the Gilmore City formation or it may represent some portion of the Chouteau formation of Missouri.

The Gilmore City formation is present throughout the north central basin from Gilmore City to Alden. In the Webster City well in Hamilton County the Gilmore City formation is over 100 feet in thickness and is apparently overlain by a few thin beds of St. Louis limestone. The St. Louis is exposed in the valley of the Boone River a short distance south of Webster City. In this well the Gilmore City is underlain by 180 feet of dolomitie limestone which should be referred to the Hampton formation. The Hampton formation is underlain by the Sheffield formation of Upper Devonian age. The Gilmore City-Hampton contact is at 230 feet.

At Boone only 30 feet of material can be referred to the Gilmore City formation. It is overlain by the St. Louis formation and underlain by 20 feet of shale which lies above the typical Hampton dolomites. The base of the Hampton formation in this section is marked by the oölitic *Schellwienella* zone which marks the base of the formation at LeGrand, Iowa. The Hampton formation is underlain by the Chattanooga shale which is in turn underlain by the Sheffield shales of Devonian age. The true relation between the Sheffield and Chattanooga is shown in this section. The black shales of Chattanooga age are deposited on the uppermost limestone beds which occur at the top of the Sheffield section. The upper contact of the Gilmore City formation is placed at 470 feet and the lower contact at 500 feet.

The Gilmore City formation thins rapidly toward the south and east and is not recognized in the wells at Des Moines.

The distribution of the Gilmore City formation in Iowa shows that a basin of deposition existed in late Kinderhook times with its deepest portion running from Fort Dodge southwest through north-east Greene, central Carroll, southeastern Crawford, northwestern

SUBSURFACE MISSISSIPPIAN CORRELATION CHART

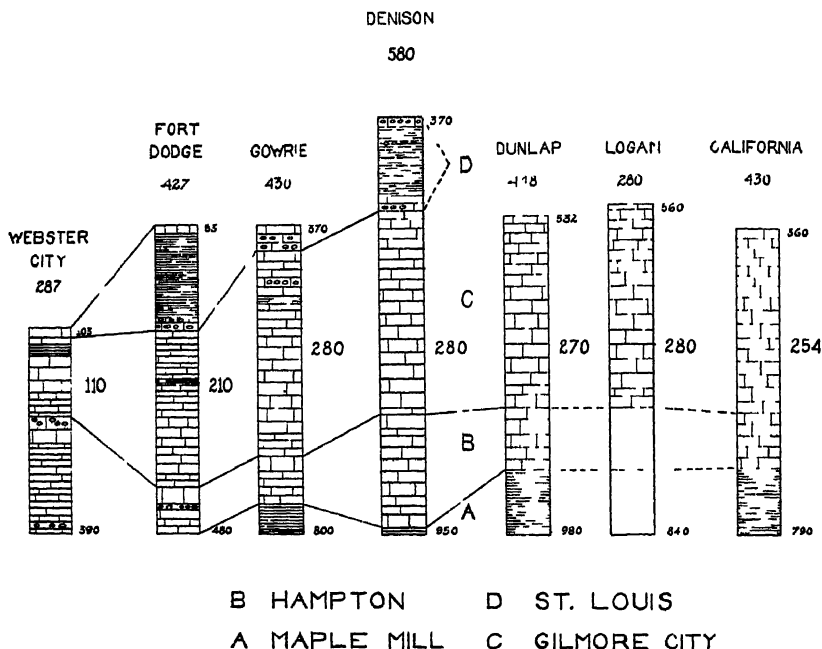


Figure 6. Subsurface Mississippian correlation chart for western Iowa.

Shelby, and central Harrison counties. The formation thins rapidly to the north from this axis and is overlain by the St. Louis formation. Southward from this axis it also thins quite rapidly but is overlapped by the cherty Osage limestone formations.

STRUCTURE

Because of the mantle of glacial drift which obscures the region, it is difficult to determine the type of structure which brings the Gilmore City formation to the surface. Since the formation is exposed at the grass roots in many places in the type area, it becomes evident that this region was a topographic high at the time of the glacial invasion.

The dip of the formation at Gilmore City is to the northeast at a low angle. The direction of dip changes to east a short distance to the east of Gilmore City. At Humboldt the direction of dip is to the southeast. These surface relations would suggest either a low fold with an axis to the south of the Gilmore City area or a

fault trending northwest southeast located somewhere to the south of the Gilmore City area.

The area immediately around Gilmore City has long been known for its sink holes. The area at one time had a large number of sinks scattered over the surface, but it becomes very questionable as to whether the topographic features referred to in this region at the present time as sinks are correctly named. Certainly their origin is slightly different from the origin of the usual sink hole.

At one time the surface of the limestone in this region was well covered with sink holes which led downward to a very well defined subterranean drainage system. It seems probable that the region was at one time underlain by extensive caverns. This underground drainage system is still present as evidenced by the fact that the farms of the region are drained into these sinks. At the time of heavy rains a downward suction may be observed in almost all of the larger holes. Quarrying in the region has been hindered by these large sink holes which are now filled with marine muds and shales. In addition to the sink holes, large numbers of underground channels filled with marine shale and having no immediate connection to the surface may be seen in the quarry faces.

The features referred to as sinks in this region have had their origin in somewhat this manner. These old sink holes filled with marine shale were covered with glacial drift. Ground water percolating down through the drift has gradually reopened some of the connections to the old underground drainage system. The drift immediately overlying the opening has gradually been carried down into the underlying limestone and deposited in the crevices in the rock. The sinks themselves consist of a crater-like depression in the glacial drift ending in a leached crevice in the limestone surface. The origin of these sink-like depressions has been mainly a mechanical process rather than a chemical process. There are often as many as a dozen of these depressions to the square mile in the immediate vicinity of Gilmore City.

Sink holes and caverns are not usually developed in a region which is not well dissected by an extensive river system. In 1928 a deep well was drilled at Manson in Calhoun County some twenty miles southwest of Gilmore City. The drill should have entered the Mississippian limestone about 300 feet beneath the surface. Instead the well was drilled for 1211 feet without penetrating anything but arkose and shale. The well was stopped while still drill-

ing in arkosic material. The drill should have entered the lower Ordovician strata at this depth. The material represented in this well has apparently been deposited in a deep river valley cut into the upper surface of the Paleozoic beds. The sinks and caverns in the Gilmore City limestone were very likely formed in connection with this river system.

There are two possibilities for the age of the shales and arkoses found in the Manson well. Gilmore City and Manson are both within the area of deposition of the Pennsylvanian and Cretaceous. Dr. A. C. Tester of the University of Iowa has made a very extensive study of Cretaceous sediments in Iowa and has expressed the opinion through personal communication that the highly arkosic sediments found in the lower portion of the Manson well are not Cretaceous in age. Since Pennsylvanian sediments exposed in the region are often coarsely elastic and Cretaceous sediments are usually shales, it would appear that the deep river valley at Manson was cut before Pennsylvanian times. This would make the uplift which developed the extensive caverns and sink holes in the region post-Kinderhook pre-Pennsylvanian in age. All of the shales which are found in the sink holes at Gilmore City need not necessarily be of Pennsylvanian age however since the Cretaceous sea undoubtedly covered the area.

Additional evidence supporting the Pennsylvanian age of the uplift which formed the sink holes may be found in the vicinity of Alden in Hardin County. The Alden limestone correlates with the Gilmore City limestone and is of the same lithologic character. Sink holes filled with marine shale are found in the quarry at Alden. These sink holes are almost identical in appearance with those of the Gilmore City area. Since the Pennsylvanian sediments are exposed in the immediate vicinity of Alden and the nearest exposure of the Cretaceous is a considerable distance to the west, it would seem likely that the shales in the sink holes at Alden are of Pennsylvanian age.

PALEONTOLOGY

Approximately 70 species of marine invertebrates have been collected from the Gilmore City limestone in the past three summer field seasons. Taken as a whole the formation is not particularly fossiliferous although a few zones will yield a fairly large fauna. The fauna is distributed in the following proportions: Coelenterata 6, Echinodermata 32, Molluscoidea 15, and Mollusca 21.

The Rhynchopora Zone: Fossils are exceptionally abundant in the blue shaly dolomite of the *Rhynchopora* zone. Slabs of the stone from the upper portion of the zone are often well covered with brachiopod shells and bryozoans. The following fauna was collected from the quarries at Gilmore City.

Corals

Cyathophyllum glabrum Keyes

Michelinea placenta White

Crinoids

Rhodocrinus cavanaughi n.sp.

Rhodocrinus douglassi var. *constrictus* n.var.

Rhodocrinus douglassi var. *serpens* n.var.

Dichocrinus multiplex n.sp.

Culmicrinus thomasi n.sp.

Brachiopoda

Chonetes multicosata Winchell

Productus scdaliensis Weller

Rhynchopora cooperensis (Shumard)

Spirifer centronatus Winchell

Spiriferina solidirostris Winchell

Eumetria verneuiliana (Hall)

Cliothyridina obmaxima (McChesney)

Cliothyridina incrassata (Hall)

Two species of echinoids and one starfish from the *Rhynchopora* zone are now being described by Dr. G. A. Cooper of the United States National Museum.

Rhynchopora cooperensis and *Spirifer centronatus* are the most commonly occurring brachiopods in the zone. One species of echinoid and *Rhodocrinus douglassi* var. *serpens* also occur fairly abundantly in the zone. The lower portion is usually crowded with fucoids.

The Rhodocrinus Zone: The crinoid "nests" are all located within this zone. Most of the other fossils that have been collected from this zone have been associated with the crinoids. The most nicely preserved fossils in this zone are obtained in green shale lenses between the massive beds of gray limestone. Fossils may be obtained by breaking the gray limestone but their preservation does not compare with that of the shale partings. The following fauna has been collected from the *Rhodocrinus* zone in the two quarries at Gilmore City.

Corals

Cyathophyllum glabrum Keyes*Michelinia placenta* White

Blastoids

Orophocrinus sp.

Cystoids

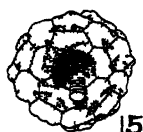
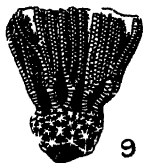
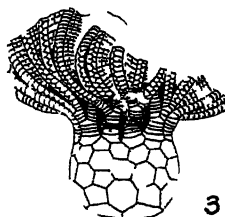
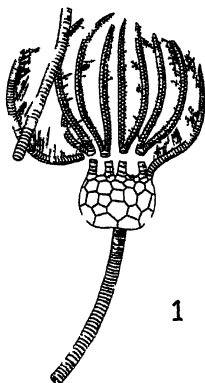
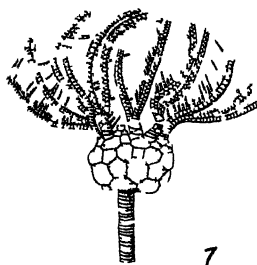
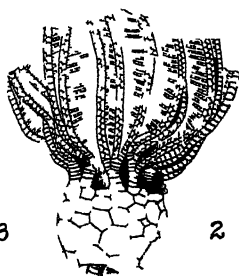
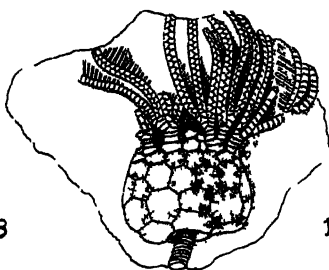
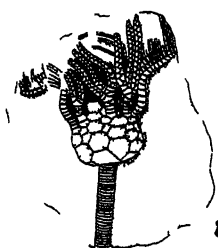
Agellacrinites sp.

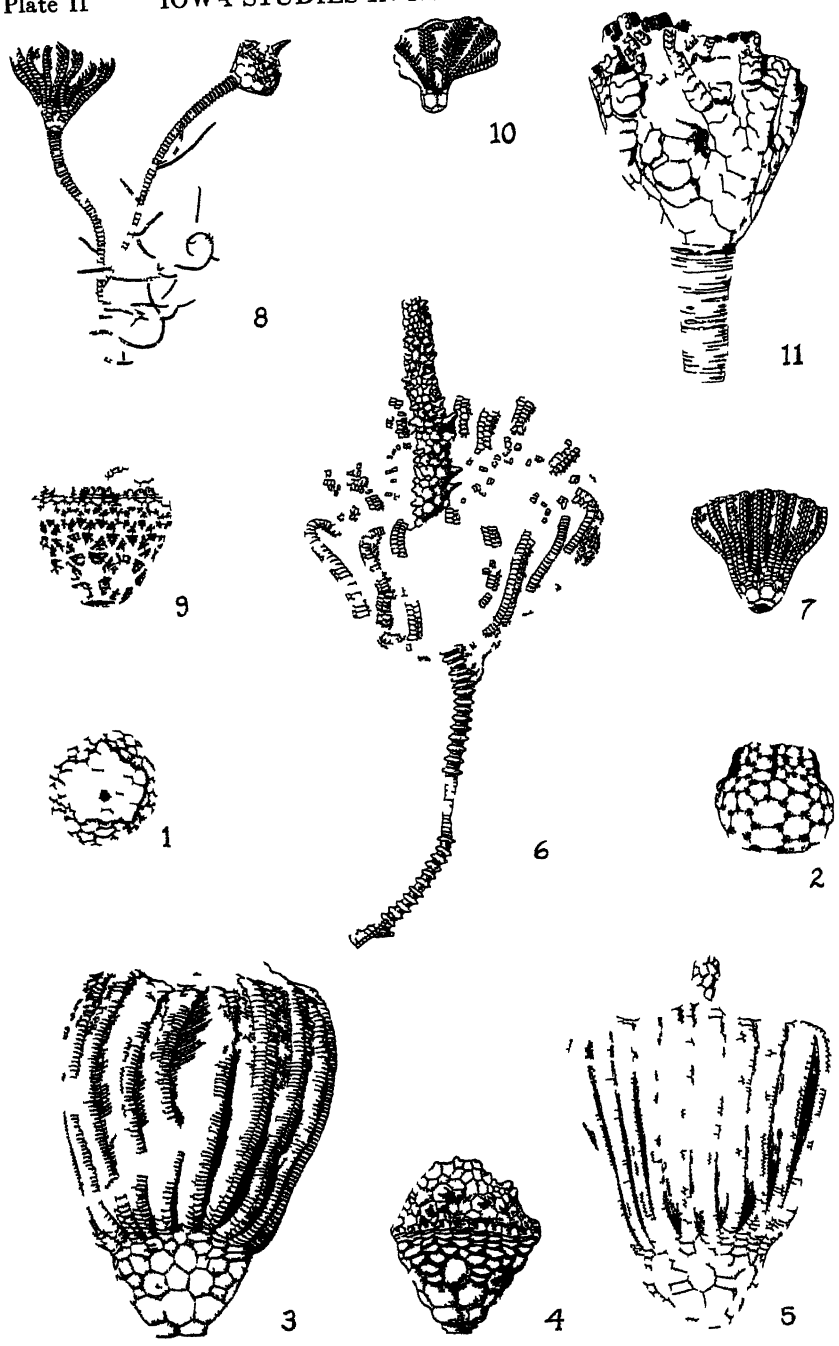
Crinoids

Rhodocrinus watersianus Wachsmuth and Springer*Rhodocrinus douglassi* Miller and Gurley*Rhodocrinus douglassi* var. *serpens* n.var.*Rhodocrinus douglassi* var. *multidactylus* n.var.

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- Eretmocrinus tentor* n.sp.
Aorocrinus iola n.sp.
Dichocrinus multiplex n.sp.
Dichocrinus campto n.sp.
Dichocrinus bozemansensis (Miller and Gurley)
Cactocrinus imperator n.sp.
Tarocrinus dero n.sp.
Pachylocrinus fimbria n.sp.
Pachylocrinus cirrifer n.sp.
Zicacrinus compactus n.sp.
Culmicrinus thomasi n.sp.
Decadocrinus douglassi (Miller and Gurley)
Gilmocrinus iowensis n.sp.
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Goniocrinus maximus n.sp.

Brachiopoda

Productus sedulicnsis Weller

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Streptorhynchus ruginosa (Hall and Clarke)

Rhynchopora cooperensis (Shumard)

Spirifer centronatus Winchell

Spirifer calvini Weller

Eumetria verneuliana (Hall)

Cliothyridina obmarima (McChesney)

The echinoids and starfishes of this horizon have also been sent to Dr. G. A. Cooper of the National Museum for description. The echinoids of this zone are excellently preserved. A large number of slabs have been found which were completely covered with crushed specimens of echinoids with the spines attached to the body. Certain thin layers of limestone are made almost entirely of crushed matted specimens of these echinoids.

The distribution of the crinoids within the shale partings and the relation of these shaly lenses to the zone itself is quite interesting. At least 75 per cent of the thousands of specimens of crinoids that have been taken from the two quarries have come from three shaly lenses located on the east wall of the Pennsylvania Dixie Quarry. Other smaller lenses containing crinoids have been located throughout both quarries but none compares with the three large

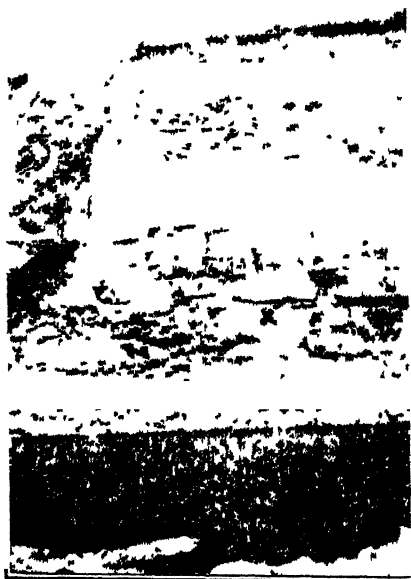


Figure 7. *Ehodocrinus* zone marked by X; Pennsylvania Dixie Quarry.

ones. "Nest" number one was the first located and was found about midway between the north and south ends of the quarry. It was characterized by a large number of forms of *Eretmocrinus tentor* and a number of species of *Rhodocrinus*. A large number of small inadunate crinoids were also found in this "nest." It was a lenticular shaped shale mass located in a depression on the limestone surface which was about seven feet long and three feet wide at its maximum dimensions.

"Nest" number two was located about 50 feet north of number one at almost exactly the same horizon. It is possible to trace the bedding planes between the two locations and yet the relative abundance of species within each group is considerably different. This "nest" was characterized by a large number of individuals of *Rhodocrinus* with an almost complete absence of specimens of *Eretmocrinus tentor*. *Cactocrinus imperator* was not present in "nest" number one and appeared fairly abundantly in this assemblage. This shaly lense was considerably larger than that of "nest" number one areally, but was at no place as thick. The crinoids were distributed over some 12 feet of limestone surface. Crinoids are still available in this shale bed farther back into the quarry face.

"Nest" number three was located about 125 feet north of "nest" number two. This fossiliferous lense appears to be in a slightly higher horizon than the other two. It was characterized by great numbers of specimens of *Cactocrinus imperator*. Specimens of *Rhodocrinus*, *Eretmocrinus*, and a number of small inadunate forms occur in the fauna but make up a very minor portion of it. Crinoids are still available in this "nest" but they occur between massive ledges of very resistant limestone. The forms collected were along a weathered solution channel which happened to traverse the bed at this point.

A horizon near the upper portion of the *Rhodocrinus* zone on the west face of the Pennsylvania Dixie Quarry has yielded a great number of specimens of *Dichocrinus multiplex*.

The crinoids are by far the most commonly occurring fossils in the *Rhodocrinus* zone. *Eretmocrinus tentor*, *Culmicrinus thomasi*, *Gilmocrinus iowensis*, *Cactocrinus imperator* and *Dichocrinus campto* are good index fossils of this zone. Among the brachiopods *Eumetria verneuilliana* occurs very abundantly in association with

occasional specimens of *Cliothyridina obmarima* and *Spirifer calvini*.

The Streptorhynchus Zone: The fauna of the *Streptorhynchus* zone is not large nor are the individuals abundant within the zone. Had it not been for the fact that blasting in the quarry has prepared a tremendous amount of material from this zone for observation, the number of specimens collected would have been quite limited. The following fauna was collected from this zone in the quarries at Gilmore City.

Corals

- Aulopora geometrica* Girty
- Syringopora scircularia* Girty

Crinoids

- Rhodocrinus douglassi* var. *serpens* n.var.

Echinoidea

- Echinoid spines

Brachiopoda

- Streptorhynchus ruginosa* (Hall and Clarke)
- Rhynchopora coopereensis* (Shumard)
- Spirifer centronatus* Winchell
- Eumetria vernuciliana* (Hall)
- Cliothyridina obmarima* (McChesney)
- Seminula pusilla* Girty

Gastropoda

- Omphalotrochus springvalensis* (White)
- Capulus triblosus* (White)

The Cyathophyllum Zone: This zone is not an abundantly fossiliferous horizon at any locality. In the Gilmore City quarries it is particularly unfossiliferous. One thin bed about 12 feet above the *Streptorhynchus* zone is filled with slender cyathophylloid corals. This bed is usually within a few feet of the upper surface of the quarry. Cross sections of the corals may be seen on the faces and ends of slabs in great abundance in this one narrow horizon. The following fauna was collected from the zone at Gilmore City.

Corals

Amplexus blairi Miller*Cyathophyllum* sp.

Gastropoda

Omphalotrochus springvalensis (White)*Straparollus macromphalus* Winchell

The *Cyathophyllum* zone is exposed along the Des Moines River Valley just downstream from the village of Rutland. At this exposure the zone is characterized by exceptionally large oölites. The limestone is very hard and consequently does not offer exceptionally good collecting. *Cyathophyllum* and *Omphalotrochus springvalensis* may be seen quite abundantly in the dense limestone.

About 90 per cent of the fauna known from the *Cyathophyllum* zone has been obtained from one exposure on the north bank of the Des Moines River just downstream from the bridge, on State Highway number 20, in the city of Humboldt. About 15 feet of oölitic limestone is exposed, which for some reason has become very much weathered. The cementing material for the oölites has been removed leaving a crumbling mass. This is the exposure from which Sardeson¹⁰ collected his fauna from the Humboldt oölite. The fossils occur mainly in lenses about eight feet above the level of the water. The following fauna has been collected from the *Cyathophyllum* zone at Humboldt.

Corals

Zaphrestis sp.*Amplexus blairi* Miller*Cyathophyllum* sp.

Crinoids

Dichocrinus sp.

Brachiopods

Streptorhynchus ruginosa (Hall and Clarke)*Rhynchotreta gibbosum* (Greger)*Diclasma* sp.*Spirifer centronatus* Winchell*Martinia lata* Girty*Eumetria perstrialis* Rowley

¹⁰ Sardeson, F. W., The Carboniferous Formations of Humboldt, Iowa: Amer. Geologist, vol. 30, p. 300, 1902.

Pelecypods

- Macrodon blairi* Miller and Gurley
Conocardium cuneatum Hall
Lciopteria subovata Miller and Gurley
Schizodus scidalensis Miller and Gurley

Gastropods

- Bellerophon blairi* Miller and Gurley
Bellerophon sublucris Hall
Bellerophon pannus White
Bellerophon sp.
Pleurotomaria sp.
Worthenia sp.
Murchisonia quadricincta Winchell
Omphalotrochus springvalensis White
Straparollus macromphalus Winchell
Strophostylus carlyana (Hall)
Holopea conica Winchell
Platyceras sp.
Loxonema sp.
Eotrochus concurrens (Hall)

At first glance one is impressed with the similarity of this fauna with that of the Spergen formation of the Meramec. A close examination of this fauna however will reveal that it is not the Spergen fauna and that it is far older. It has its closest affinities with the molluscan fauna of the Wassonville member of the Hampton formation of Iowa.

CORRELATION

The writer believes that the Gilmore City formation represents an eastward invasion of some portion of the Madison sea of the west. Its stratigraphic position, its fauna, its lithology, and its distribution all point toward this correlation. Should this correlation later prove to be correct, it is obvious that a much more satisfactory basis for determining the correct age of the Madison limestone itself will have been established. The writer is also of the opinion at the present time, although very little evidence could be advanced to support this opinion, that the Madison of the west does not correspond in time interval to as much of the Mississippi Valley Mississippian as has been heretofore supposed. The follow-

ing evidence is presented in support of the Madison-Gilmore City correlation.

Stratigraphic position: Since the lower contact of the Gilmore City formation is not exposed in the type area, the relation of its correlative, the Alden limestone of Hardin County, to the underlying formations becomes important.

The Alden limestone was correlated with the Gilmore City formation by the writer¹¹ in 1931. The stratigraphic positions of the two formations are identical. Their lithological character is very similar and is entirely different from any other Iowa limestone. The sink holes filled with marine shales are very similar in both limestone formations and are not found in other limestone formations in Iowa. The Gilmore City limestone may be traced continuously in well sections from Gilmore City to Alden.

The Alden limestone lies unconformably on the upper eroded surface of the Iowa Falls member of the Hampton formation. The unconformity is so sharp that the entire thickness of the Iowa Falls member is beveled by the Alden limestone in a distance of about three miles. The lower portion of the Hampton formation of Iowa is correlated zone for zone with the Chouteau limestone of Missouri. The upper three members of the Hampton formation comprising some 200 feet of strata are younger than any portion of the Chouteau of Missouri. The upper portion of the Hampton formation however is not separated from the lower portion by an unconformity and its fauna is definitely derived from the Chouteau fauna. The Gilmore City formation was deposited upon the upper eroded surface of a formation that has heretofore been considered to be the youngest known Kinderhook.

In all of the surface exposures of the Burlington limestone in Iowa its lower contact is marked by an unconformity. In eastern Iowa the Burlington limestone overlaps against the Kinderhook surface and each of the zones of the Burlington may be found in contact with the underlying Kinderhook in definite order towards the north and west. The Fern Glen-St. Joe horizon is entirely missing in the eastern Iowa section. The lower portion of the lower Burlington of Missouri is also missing in the type section at Burlington. In western Iowa the cherty Osage formations definitely overlap onto the Gilmore City surface. The Gilmore City lime-

¹¹ Laudon, L. R., *Stratigraphy of the Kinderhook Series of Iowa*: Iowa Geol. Survey, vol. 35, p. 416, 1929.

stone may be seen from these relations to occupy a position between what used to be considered uppermost Kinderhook and the earliest Osage.

Lithologic Character: In the Madison limestone of Wyoming and Montana and in the Pahasapa limestone of the Black Hills, may be seen considerable amounts of pure light gray limestone. The purity and color of the Gilmore City limestone resembles these western limestones very much. Such a lithologic similarity is undoubtedly of little significance when considered over such large distances. However, since these same light gray colors are characteristic of the Madison over tremendous distances, they may be of some value in this case.

Paleontological relationships: An analysis of the Gilmore City fauna yields a tremendous amount of information with regard to its age. In the fauna consisting of some 70 species of invertebrates about 41 may be positively identified. These forms are distributed in the following manner: Kinderhook 19, Madison 19, Osage 16, and Meramec 6. A critical analysis of the fauna would indicate that it was younger than the Hampton of Iowa. The presence of *Rhodocrinus watersianus*, *Productus sedaliensis*, *Spiriferina solidirostris*, *Spirifer centronatus*, *Spirifer calvini*, *Eumetria vernicilliana*, *Cliothyridina incrassata*, *Macrodon blairi*, *Liopteria suborata*, and *Straparollus macromphalus* are very characteristic of the Hampton formation. The presence of *Aulopora geometrica*, *Syringopora sercula*, *Rhodocrinus douglassi*, *Dichocrinus bozemanensis*, *Seminula pussila*, *Seminula humilis*, *Spirifer centronatus*, *Martinia lata*, and *Straparollus ophirensis* suggest very strongly the Madison.

A comparison of the Gilmore City fauna with faunas collected from the Pahasapa limestone of the Black Hills, the Madison limestone of Montana, and the Upper Banff limestone of Lake Minnewanka, Alberta, show that most of the Gilmore City forms may be duplicated in these western formations. Since the western faunas are very incompletely described at the present time, definite comparisons cannot be made.

These western Mississippian formations are all characterized by an abundance of varieties of *Spirifer centronatus*. The Gilmore City fauna is very definitely a *Spirifer centronatus* fauna since that form occurs far more abundantly than any other form. None

of the limestone of Mississippian age in the Mississippi Valley older than Meramec are characterized by large numbers of individuals of the genus *Syringopora*. *Rhynchopora cooperensis* which occurs very abundantly in the Gilmore City formation was identified by the writer as *Camurotoechia metallica* for a considerable period of time. Its external appearance is almost identical with that of *Camurotoechia metallica*. However after sectioning, it appears very definitely to be a form of *Rhynchopora*.

The most conclusive evidence as to the age of the Gilmore City formation is found in the erinoid fauna. Generically it appears very similar to that of the LeGrand erinoid fauna from the Hampton formation. A great number of the forms appear to have been directly descended from the LeGrand species. The *Rhodocrinus douglassi* type with the flat nodose tegmen is directly foreshadowed by an undescribed form in the LeGrand fauna. The smooth plated species of *Rhodocrinus* represented by *R. watersianus* in the LeGrand beds, appear in the Gilmore City fauna with a variety of different types of arm structure. The large *Eretmocrinus* is merely a specialized *Batocrinus* and is probably directly in the line of ancestry with the exceptionally wide armed forms from the Burlington limestone. *Cuctocrinus imperator* is a specialized larger form of *C. arnoldi*. *Eutaxocrinus dero* is very closely related to *Eutaxocrinus fletcheri*. *Dichocrinus bozemanensis* with its striated calyx and flaring base is related to *D. cinctus*. *Dichocrinus multiplex* is a smaller, more delicate form of *Dichocrinus inoratus*. The greatest variation is found in the small inadunate crinoids. Such forms as *Culmicrinus* and *Gilmocrinus* have no representatives in the LeGrand fauna.

The fauna may be readily determined to be much older than typical Osage by the lack of such early Osage genera as *Macrocrinus*, *Agaricocrinus*, *Uperocrinus*, and *Eutrochocrinus*.

In 1896 and 1897, Miller and Gurley¹² described a group of erinoids from the Madison limestone which were collected by Earle Douglass in Bridger Canyon a few miles north of Bozeman, Montana. In this collection of erinoids were several species of *Rhodocrinus*, a *Batocrinus*, two species of *Dichocrinus*, several species of *Platycrinus*, and several small inadunate crinoids belonging to the family Poteriocrinidae. A recent visit to the area in which these

¹² Miller, S. A., and Gurley, F. E., New Species of Crinoids, Cephalopods, and other Paleozoic Fossils: Bulletins 10, 12, Ill. State Museum of Nat. History, p. 40, 1897.

forms were collected has added a few more specimens for comparison. The type specimens of this fauna have all been made available for study. Two of the species of *Rhodocrinus* are quite unlike any forms from the Gilmore City. *Rhodocrinus douglassi* however is one of the most commonly occurring Gilmore City species. The flat topped species of *Rhodocrinus* are not found in other Mississippian formations in the Mississippi Valley. *Dichocrinus bozemanensis* is also identical with one of the Gilmore City forms and is so unlike any other forms of *Dichocrinus* that it may be considered a good index fossil. One of the forms was described as *Potriocrinus douglassi* and upon examination by the writer has turned out to be a species of the new genus *Gilmocrinus*. Since species belonging to the Poteriocrinidae with only five arms are not known in any other Mississippian formations, the presence of this five armed form in the Madison shows a close relationship between the two faunas. The Madison crinoid fauna as a whole, however, carries several forms which are indicative of a slightly younger horizon. A very perfect form which appears to be identical with *Platycrinus burlingtonensis* appears quite commonly. A large form of *Steganocrinus* considerably larger than any of the Burlington species is present in the fauna. The presence of this genus would ordinarily indicate a horizon younger than Kinderhook.

Distribution: The Gilmore City formation may be determined through well sections to be an eastward overlap into Iowa onto the Kinderhook surface. No attempt has as yet been made to trace this formation on west through Nebraska and Kansas. It may curve northward to connect with the Pahasapa limestone of the Black Hills or it may continue directly across Nebraska and Kansas to connect with the Mississippian of the front ranges. There may be no continuous subsurface connections at the present time since known post-Mississippian uplifts in Kansas and Nebraska have caused the removal of considerable portions of the section by erosion. The formation is nearly 200 feet in thickness in many places along the Iowa-Nebraska line from Nebraska City to Sioux City and can undoubtedly be traced into Nebraska for considerable distances.

CONCLUSIONS

It would appear that the entire Madison formation of the west might possibly be post-Hampton in age. It would also appear that great portions of the Madison might possibly be pre-Osage in age.

GILMORE CITY FORMATION

35

CHART SHOWING RANGE OF FAUNA

Species that are new and species that cannot be positively identified are not listed.		MADISON	KINDERHOOK	OSAGE	MERAMEC
<i>Coelenterata</i>					
Amplexus blairi				x	x
Cyathophyllum glabrum				x	
Michelinea placenta	x				
Aulopora geometrica	x				
Syringopora sercularia	x				
<i>Echinodermata</i>					
Rhodoerinus watersianus		x			
Rhodoerinus wortheni				x	
Rhodoerinus douglassi	x				
Dichocerinus bozemanensis	x				
Decadoerinus douglassi	x				
<i>Molluscoidea</i>					
Streptorhynchus ruginosa				x	x
Chonetes multicosta		x		x	
Productus sedaliensis		x		x	
Rhynchopora cooperensis				x	
Rhynchotrete gibbosum				x	
Seminula pussila	x				
Seminula humilis	x				
Spiriferina solidirostris	x	x			
Spirifer contronatus	x	x	x		
Spirifer calvini		x			
Martinia lata	x				
Eumetria perstrialis			x	x	
Eumetria verneuilliana	x	x			
Cliothyridina obmaxima	x	x	x		
Cliothyridina incrassata		x	x		
Cliothyridina crassiscardinalis	x		x		
<i>Mollusca</i>					
Macrodon blairi		x			
Conocardium cuneatum					x
Leiopteria subovata		x			
Schizodus sedaliensis		x			
Bellerophon sublaevis				x	x
Bellerophon panneus		x	x		
Bellerophon blairi		x	x		
Straparollus macromphalus		x			
Straparollus ophirensis	x				
Murchisonia quadricincta					x
Phanerotrema brazeriana	x				
Omphalotrochus springvalensis		x			
Strophostylus carleyana	x				
Holopea conica		x			
Platyceras tribulosus		x			
Eotrochus concavus					x

The old interpretation which suggests that the Madison sea was present in the west during most of Mississippian times may in time prove to be absolutely true. At the present time the writer is in no position to make any statements with regard to the age of the entire Madison formation. The Gilmore City formation is equivalent to some portion of the Madison. Careful zone for zone stratigraphy within the Madison may later allow a closer correlation.

THE CRINOID FAUNA OF THE GILMORE CITY FORMATION

The most striking portion of the invertebrate fauna of the Gilmore City formation is found in the exceptional crinoid fauna. Thousands of specimens of crinoids have been collected from the ledges of the *Rhynchopora* and *Rhodocrinus* zones. A large number are excellently preserved, often showing the most delicate cirri and pinnules. The specimens are preserved in a soft green flour like marl between massive ledges of limestone. Later work in the area may reveal that crinoids showing the arms are more abundant in this formation than they were in the famous Kinderhook crinoid bed at LeGrand, Iowa. At present they are much more widely distributed in the possible area of exposure at Gilmore City than they ever were at LeGrand. The soft nature of the marl in which the specimens occur at Gilmore City makes cleaning and preparation of specimens for study difficult.

A great number of echinoids occur along with the crinoid fauna. They also show the same excellent preservation which characterizes the crinoids. Thousands of specimens of complete echinoids showing all of the spines have been collected from the ledges.

Starfishes are not as common in occurrence but appear occasionally in association with the crinoids and echinoids.

DESCRIPTIONS OF SPECIES

Order CAMERATA Wachsmuth and Springer

Family RHODOCRINIDAE Roemer

Genus *Rhodocrinus* J. S. Miller

Rhodocrinus watersianus Wachsmuth and Springer

Plate I, Fig. 1.

1899. *Rhodocrinus watersianus* Wachsmuth and Springer, Ill. Geol. Surv., vol. 8, p. 184, pl. 12, fig. 16.

1899. *Rhodocrinus watersianus* Wachsmuth and Springer, Harvard Mus. Comp. Zool., Mem. 9, p. 221, pl. 12, fig. 9.

A small smooth form with a rounded globular calyx; averaging

about 30 mm. from base to tips of arms. Dorsal cup typically 9 mm. in width and 7 mm. in height. Arms constricted at their lower portion and flaring at their mid-length.

Dorsal cup. Infrabasals small, hidden in basal concavity. Basals large and curved abruptly inward to form a portion of the basal concavity. Radials heptagonal, smaller than basals, confined to lateral walls of calyx. Costals two, the first usually pentagonal, the second hexagonal, of nearly equal size. Distichals one, followed by five or six free arm pieces before the first bifurcation. Normal interbrachial series 1221 or 1222. Primary interbrachial slightly smaller than radials. Anal slightly larger than radials; followed by supplementary pieces which end in an eccentric high pyramid on the tegmen. The anal plate is usually followed by 332 plates in the succeeding cycles.

Tegmen. Inflated, laterally constricted, half the width of the calyx. Posterior oral large. Anus eccentric, in the form of a high rounded pyramid.

Arms. Slender, incurved at tips, four to each ray making twenty for the species. Arms constricted until they branch, above which they flare considerably. Proximal distichal followed by five or six free plates before the arms branch. The change from uniserial to biserial structure is accomplished on the third or fourth brachial above the branching of the arms. Pinnules long, slender, and closely set together.

Column. A typical *Rhodocrinus* stem, with little variation throughout its length. Columnals slightly closer together immediately below calyx. Each columnal is slightly expanded at its mid-portion; however, there is no differentiation in the amount of expansion. The cirri have not been observed.

Relationships. This form is very closely related to *R. coranus*, *R. wortheni*, and *R. wachsmuthi* but it differs from all members of this group in that it carries only four arms to the ray. Typical forms of *R. watersianus* from both the LeGrand and Gilmore City beds occasionally carry five arms to the ray, thereby showing their affinity to *R. wortheni*. These are apparently transitional forms between *R. watersianus* and *R. wortheni* which carries six arms to the ray. *R. bozemanensis* from the Madison limestone of the West carries only four arms to the ray and differs from *R. watersianus*

in that it has an exceptionally large stem for the size of its calyx and also that its arms are exceptionally small for the size of the calyx.

R. watersianus is not an abundantly occurring form in the fauna. It appeared most abundantly in "nest" No. two in the Pennsylvania Dixie Quarry. It is apparently confined to the *Rhodocrinus* zone.

Occurrence. Gilmore City formation, Gilmore City, Iowa. This species was originally described from the Kinderhook series at LeGrand, Iowa.

Figured specimen. State University of Iowa, No. 2053.

Rhodocrinus wortheni Hall

Plate I, Figs. 2-3

1858. *Rhodocrinus wortheni* Hall, Iowa Geol. Survey, vol. 1, pt. II, p. 556, pl. 9, fig. 8.
1881. *Rhodocrinus wortheni*, Wachsmuth and Springer, Revision of the Paleocrinoidea, pt. II, p. 220.
1897. *Rhodocrinus wortheni* Wachsmuth and Springer, Harvard Mus. Comp. Zool., Mem. 9, vol. 1, p. 220.

This species is very closely allied to *R. watersianus*. It differs mainly in its arm structure and in its greater size. The length of ordinary specimens including arms and calyx is about 38 mm. The height of the calyx to the arm bases is usually 12 mm. Width of the calyx typically 15 mm.

Dorsal cup. Rounded, globose, constricted at upper portion. Infrabasals hidden in basal cavity. Basals comparatively large, approximately 5 mm. in width. Radials higher than wide, averaging 4 mm. in height. First costal wider than high, smaller than radial. Second costal larger than first. Distichals comparatively large. Interbrachial series normally 1222. Primary interbrachial considerably smaller than radial. Normal anal interradius X331.

Tegmen. Unobserved.

Column. As in *R. watersianus* and others of this group.

Arms. Having typically six arms to the ray with the exception of the anterior ray which usually has only four. *R. watersianus*, its closest relative, carries only four arms to the ray. The arms

of *R. wortheni* are long, slender, and uniserial in their lower portion. The change from uniserial to biserial structure takes place on the third brachial above the second branching of the arms.

Relationships. Occasional specimens of *R. watersianus* from Kinderhook beds at LeGrand, Iowa, are found with several of the rays carrying five or six arms. Apparently the variation in arm structure in these smooth plated forms of the genus *Rhodocrinus* was well founded in Kinderhook times.

In the Gilmore City formation there is every variation between the *R. watersianus* type bearing 20 arms and the *R. wortheni* type bearing 28 arms. All forms bearing more than 20 arms are referred in this paper to the species *R. wortheni*. Several new varieties might very easily be erected on the basis of this arm structure. *R. wortheni* is one of the most abundantly occurring fossils in the formation. In one gallon pail of green marl washed from "nest" No. two in the Pennsylvania Dixie Quarry, 123 specimens of this species were found.

Occurrence. Gilmore City formation, Gilmore City, Iowa. This form was originally described from the Lower Burlington beds at Burlington, Iowa.

Figured Specimens. State University of Iowa, Nos. 2054, 2055.

Rhodocrinus cavanaughi n. sp.

Plate I, Figs. 4-6.

Calyx subspherical, averaging about 15 mm. in height and a little less in width. Plates characterized by ridges radiating from their centers. A high anal pyramid appears on the tegmen.

Dorsal cup. Infrabasals large, basal concavity deeply excavated. Basals slightly larger than infrabasals; in contact laterally with the primary interbrachial except in the anal interradius. Radials slightly smaller than basals; in contact laterally with interbrachials. One costal, usually heptagonal. One distichal, above which occur free arm plates. One specimen carries two distichals in the right postero-lateral ray on the side nearest the anal interradius. Primary interbrachial hexagonal; in contact with infrabasal, and followed by 233 plates in the succeeding cycles. Interbrachials in contact with interambulacrals. Anal interradius exceptionally well defined. Anal smaller than basals, hexagonal, followed by supplementary pieces in a continuous row which runs to the base

of the anal pyramid on the tegmen. Anal interradius X3343 in the dorsal cup.

Tegmen. The eccentric anal protrusion is the most conspicuous feature of the tegmen. It is in the form of a rounded node which rises fully two mm. above the general level of the tegmen. Ambulacral plates in a definite series leading from the center of the tegmen to each ray. All plates slightly nodose. Oral plates small and inconspicuous. Arm openings directed slightly outward.

Arms. The arms of this form are unknown.

Column. A few columnals from the upper portion of the stem of this form may be seen protruding from the excavated bases of all of the specimens. As far as can be determined they are typical of the genus *Rhodocrinus*. The columnals are thin, averaging about three to 1 mm. The diameter of the stem is about 3 mm. The lumen is small.

Relationships. This form may be easily recognized from all other species of this genus by its protruding anal pyramid and its exceptionally well defined anal interradius. Most of the features of this form are duplicated in an immature way in an undescribed form of *Rhodocrinus* from the Kinderhook strata at LeGrand, Iowa. The LeGrand form is much smaller but is undoubtedly in the line of ancestry of *R. cavanaughi*.

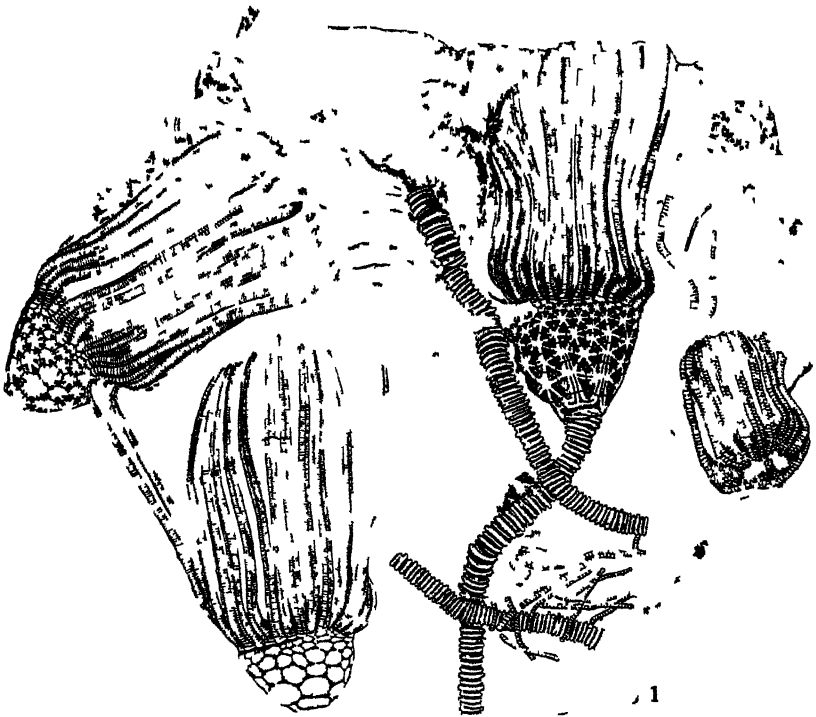
About 15 specimens of this species were found in a small shaly pocket in the blue dolomite of the *Rhynchopora* zone. The shaly pocket was found in a slab on the floor of the Northwestern States quarry. None have been located at any other place in either of the quarries at Gilmore City.

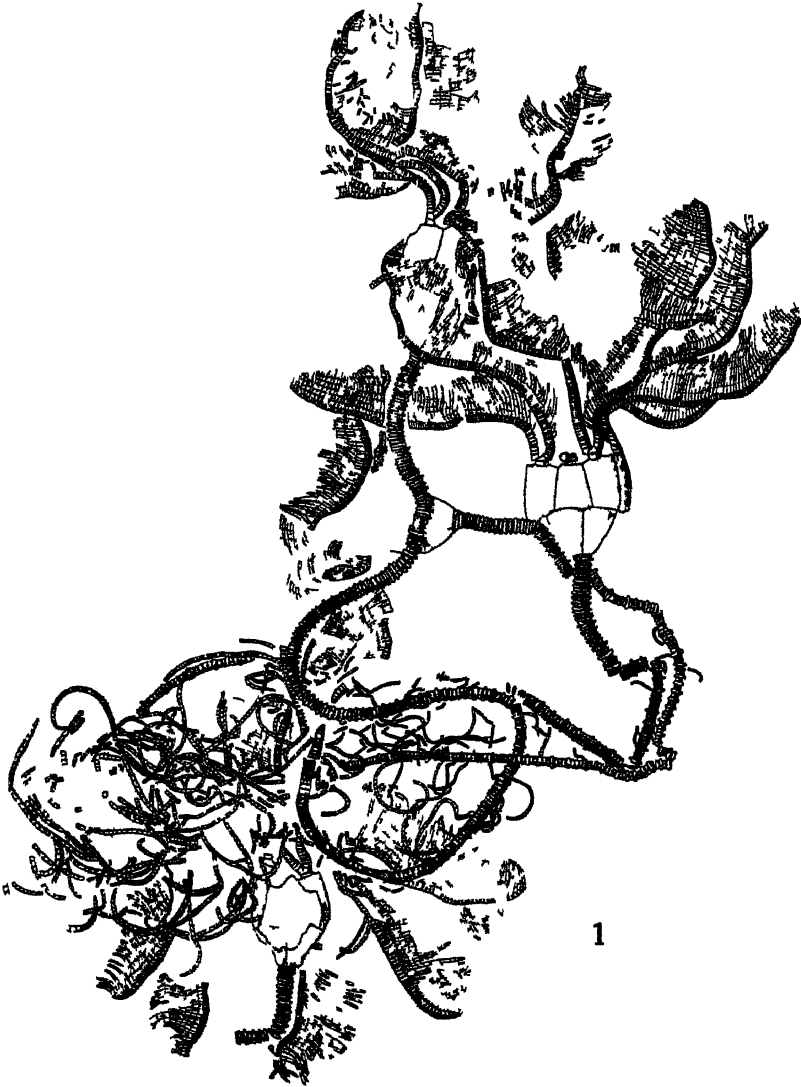
Occurrence. Gilmore City formation, Gilmore City, Iowa.

Types. State University of Iowa. Holotype No. 2060, Paratypes Nos. 2058, 2059.

EXPLANATION OF PLATE III

	Page
Fig. 1. <i>Cactocrinus imperator</i> n. sp.	51
A slab showing the holotype and two paratypes. The holotype shows the character of the stem. A crushed specimen of <i>Eretmocrinus tentor</i> n. sp. may be seen on the right margin of the slab. x 3/5.	





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Rhodocrinus douglassi Miller and Gurley

Plate I, Figs. 10-11.

1899. *Rhodocrinus douglassi* Miller and Gurley, Illinois State Mus. of Nat. Hist., Bull. 12, p. 39, pl. III, fig. 1.

This species was described from a single badly crushed specimen that had been collected by Earl Douglass in the Madison limestone in the Bridger mountains north of Bozeman, Montana. Later collections in the region have revealed much better specimens than the one figured by Miller and Gurley. Comparison of specimens now in the collection of the University of Montana with specimens from Gilmore City has shown that some are identical and others closely related. The Gilmore City formation has a large number of varieties that are all closely related to *R. douglassi*. The form that is nearest like the specimens of *R. douglassi* from the Madison limestone is not abundant in the Gilmore City fauna.

The calyx of this form is a little less regular than that of the usual *Rhodocrinus*. Width of calyx 15 mm. Height to arm bases 9 mm. Height of entire calyx 15 mm.

Dorsal cup. Infrabasals small, hidden in basal concavity. Basals averaging 4 mm. in width, curving abruptly inward to form the basal concavity. Radials larger than basals, the lower tips of radials curve around base and nearly enter basal concavity. Costals two, hexagonal, considerably smaller than radials. One distichal occupies the constriction just below the abruptly flaring portion of the tegmen. Primarily interbrachial nearly as large as radial, followed by 332 plates in the succeeding cycles. Anal interradius quite wide, normal succession of plates X3332.

Plates marked by regular radiating ridges from an acuminate central node. Ridges not sharply defined in the centers of the plates. Plates of tegmen nodose.

Tegmen. The ventral disk may be used to distinguish this group of crinoids from all other species of *Rhodocrinus*. It is flat on top,

EXPLANATION OF PLATE IV

- Fig. 1. *Dichocrinus multiplex* n. sp. 54
 A slab preserving portions of four specimens. The preservation of the long cirri on the lower portions of the stems is excellent on this specimen. x 1.

covered with nodose plates, roughly pentagonal in outline, and meets the lateral walls at an abrupt angle of about 85 degrees. It flares enough so that the arm openings are overshadowed considerably. The plates of the tegmen are much fewer in number in *R. douglassi* than in any of the other varieties which are associated with it with the possible exception of *R. douglassi* var. *constrictus*. The anal opening is not covered by the usual conspicuous pyramid of small plates.

Arms. The arms of this form have not been observed on any of the specimens from Gilmore City. A few small stumps appear on the left antero-lateral ray of the specimen figured in this report. Three arms appear on one side of this ray suggesting a 30 armed form. They branch the first time on the first palmar. The second branching is accomplished on the third brachial of the fourth order.

Column. The stem is not preserved on any of the specimens which have been referred to this species. One or two segments appear at the bottom of the basal concavity in the figured form. They appear to be similar to those which appear on other varieties of this species.

Relationships. This form may be recognized from others of this *R. douglassi* group by its exceptionally wide flaring tegmen, by the large plates which are found in the tegmen, and by the fact that the basals enter into the basal concavity slightly more than usual. The expanded tegmen of this species would suggest the genus *Gilbertsocrinus*. The arms, however, are very definitely not characteristic of the genus *Gilbertsocrinus*. This group of crinoids were foreshadowed in the Kinderhook by an undescribed species of *Rhodocrinus* that is now in the collection of B. H. Beane of LeGrand, Iowa. The LeGrand form is closely related to *R. douglassi* var. *constrictus*. The flat topped tegmen with its pentagonal outline, the laterally directed arms, and the inflated dorsal cup are all present although immaturely developed.

Occurrence. Gilmore City formation, Gilmore City, Iowa. Also found in the Madison limestone of Montana.

Figured specimen. State University of Iowa. No. 2067.

Rhodocrinus douglassi var. *serpens* n. var.

Plate I, Figs. 7-9.

A small form of *Rhodocrinus* with a round globe shaped calyx,

highly sculptured plates, and usually six arms to the ray. Width of calyx averages 9 mm. Height to arm bases 7 mm. The arms are nearly three times the length of the calyx.

Dorsal cup. Infrabasals hidden in a rather large basal concavity. Basals large, curving inward to form the outer portion of the basal concavity. Radials entirely on the lateral wall but very nearly reaching the basal concavity. Radials as large as the basals, averaging 3 mm. in height. Costals two, slightly smaller than radials, supporting a single distichal above which occur free arm plates. Interbrachial series normally 1232 or 1222. Anal inter-radius carrying a median row of plates with supplementary pieces on either side. Normal anal succession X321.

Tegmen. Flat on the upper surface with a right angled junction with the lateral wall. Arm openings laterally directed. Plates of tegmen nodose. Orals small, differentiated only with difficulty. Anal opening slightly eccentric.

Arms. Slender, branching twice usually, making six arms to the ray and thirty to the species. They branch for the first time on the sixth palmar. The second branching takes place usually on the fourth brachial above the first branch. The palmars are highly cuneiform. The brachials between the first and second branches are a mixture of uniserial, cuneiform, and biserial pieces. Occasional forms are found which carry only four or five arms in one or two of the rays.

Column. A typical *Rhodocrinus* stem with the usual monotony throughout its entire length. Columnals slightly closer together near the calyx. Cirri not observed. The stem of this form appears always to be impressed on one of the basal plates. The eccentric emergence of the stem from the basal concavity suggests the possibility that this form might have been a nodding type. A large number of stems of this form have been found coiled up like a serpent with a slight depression in the center suggesting the resting place of the crinoid calyx. It seems likely that the eccentric emergence of the stem was not inflicted after the death of the crinoid, since in all cases it actually displaces and deforms the basal plate against which it rests.

Relationships. This form is the most commonly occurring form in the *R. douglassi* group. It differs from *R. douglassi* in that the

radials are not depressed as far towards the basal concavity, the relative width of the tegmen is considerably less and it does not overhang the arm openings. The tegmen is not quite as flat on top as it is in others of the group, the plates are slightly more nodose, and the anus is more centrally located. Hundreds of specimens have been collected from the *Rhodocrinus* zone in the Pennsylvania Dixie Quarry. It is mainly because of the abundance of this form that the *Rhodocrinus* zone is so named.

Occurrence. (Gilmore City formation, Gilmore City, Iowa.

Types. State University of Iowa. Holotype No. 2061; paratypes Nos. 2056, 2062.

Rhodocrinus douglassi var. *multidactylus* n. var.

Plate I, Figs. 12-14.

This form is slightly larger than *R. douglassi* var. *serpens*. It is definitely related to this same group, however. The calyx averages 13 mm. in width and 8 mm. in height from the base to the arm openings. The calyx is relatively wider than that of *R. douglassi* var. *serpens* and the arms are proportionally shorter.

Dorsal cup. Infrabasals small, hidden in the basal concavity. Basals average 5 mm. in width and are abruptly recurved to form the rim of the basal concavity. The lower tips of the radials reach very nearly to the basal concavity making the radials proportionally smaller than in *R. douglassi* var. *serpens*. The radials average 4.5 mm. in width. Costals two, hexagonal, followed by a single distichal, above which there are free arm plates. Primary interbrachial less than half the size of the radial. Normally followed by 232 supplementary plates. The anal plate is followed by a median row of plates with supplementary plates on either side. The normal succession is X3322.

Tegmen. Flat on top with an abrupt marginal angle which gives rise to the laterally directed arm openings. Plates on the lateral edge of the tegmen are more nodose than those of the central plates. Anal pyramid eccentric, raised above the general surface, and composed of many small plates.

Arms. The structure of the arms varies somewhat within this variety. There are usually eight arms to the ray, making forty to the species. However, quite commonly 10 arms are present on each

of the rays that border the posterior interradius. Occasional forms are found with 9 rays to each of the postero-lateral rays. The arms of this form branch quite close to the calyx. When the form carries 10 arms to the ray the first branching takes place on the first palmar. The arms branch for the first time on the third or fourth brachial when only eight arms are found in the ray.

Column. This form exhibits a typical *Rhodocrinus* stem with practically no differentiation throughout its entire length. The stem is impressed in one of the basal plates suggesting a nodding type and showing its affinity to *R. douglassi* var. *serpens*.

Relationships. This form has been derived through a differentiation of the arms of *R. douglassi* var. *serpens*. The large number of arms, the branching of these arms close to the calyx, the greater width of the calyx in comparison to the length, and the depression of the radials toward the basal concavity readily distinguish this form from others of the group. This form occurs chiefly in the *Rhodocrinus* zone and does not occur abundantly in the fauna.

Occurrence. Gilmore City formation, Gilmore City, Iowa.

Types. State University of Iowa. Holotype No. 2065; paratypes Nos. 2063, 2064.

Rhodocrinus douglassi var. *constrictus* n. var.

Plate II, Figs. 1-2.

This form differs from others of the *R. douglassi* group in that it has an exceptionally rounded bottle shaped calyx and a constricted pentagonal tegmen. Height of calyx 16 mm., width 17 mm., width across top of tegmen 11 mm.

Dorsal cup. Base deeply excavated, infrabasals small, confined to bottom portion of basal concavity. Basals large, averaging 5 mm. in width. Radials nearly as large as basals, length 3 mm., width 4 mm. Costals two; first hexagonal, nearly as large as radial; second about half the size of the radial. Distichals one, with the arm openings grooved in their upper surfaces. Interbrachial area well defined, the succession of plates normally being 123221. Primary interbrachial slightly smaller than radial and succeeded by two plates that are equal in size to it. Anal plate large, followed by three irregularly arranged plates. The median row of supple-

mentary plates that usually runs up the central portion of the anal interradius is slightly offset to the left in the holotype.

The plates are marked with radiating ridges which run from the center of each plate. The ridges are well defined only in the suture region of the plates.

Tegmen. The ventral disk is sharply pentagonal with its corners directly above the rays of the dorsal cup. It is flat on top and meets the lateral walls with an abrupt angle as in other members of the *R. douglassi* group. The arm openings are directed laterally. The tegmen plates are large and only slightly nodose. The anal opening is slightly eccentric, and not raised above the general surface of the tegmen.

Arms. The arms of this form have not been observed.

Column. One segment of the stem of this form occurs at the bottom of the basal concavity of the holotype. It appears much like the stems of others of this group.

Relationships. This is probably one of the earlier representatives of the *R. douglassi* group. The first appearance of this type of crinoid is in the Kinderhook strata at LeGrand, Iowa. An undescribed form in the collection of Dr. B. H. Beane of LeGrand closely parallels this form in structure. The pentagonal tegmen on the LeGrand form is not quite as sharply defined. It appears to be very definitely a direct ancestor of *R. douglassi* var. *constrictus*.

R. douglassi var. *constrictus* may be readily distinguished from other members of this group by its expanded globular calyx and its sharply expanded tegmen. This form is apparently not common in the fauna and has at present been collected only from the *Rhynchopora* zone.

Occurrence. Gilmore City formation, Gilmore City, Iowa.

Types. State University of Iowa. Holotype No. 2057.

Rhodocrinus douglassi var. *excavatus* n. var.

Plate I, Fig. 15.

A very irregular form of the *R. douglassi* group. Height of calyx to base of arms 9 mm., width 16 mm., height of entire calyx 13 mm.

Dorsal cup. Base exceptionally deeply excavated. The basal cavity flares rapidly and is definitely pentagonal. The stem is deeply impressed into the anterior basal. Basals nearly confined to basal concavity with only their outermost edges showing on the lateral walls. The radials project slightly below the basals making a five pointed star shaped base. The remaining calyx structure is similar to that of the typical *R. douglassi* group except that the shape of the resulting calyx is quite irregular. The normal inter-brachial succession is 1221. Plates marked with radiating acuminate ridges.

Tegmen. The tegmen is very irregular and has lost almost all of its pentagonal shape. The five corners above the rays may still be recognized although they are ill defined. The plates of the tegmen are considerably smaller than in other forms of this group. The tegmen is flat, the arms are directed laterally, and the plates are slightly nodose as in others of the group. The anus is eccentric and not raised above the general level of the tegmen.

Column. Only a small portion of the stem of this form has been observed. Some eight segments are found in the basal cavity of the holotype which show the stem to be similar to other stems of the *R. douglassi* group.

Relationships. This form is the most irregular of the *R. douglassi* group and may be quite easily distinguished from the others. The exceptionally deep star shaped basal concavity serves to distinguish it from the others. This form does not occur abundantly in the fauna. All specimens were collected from the *Rhodocrinus* zone.

Occurrence. Gilmore City formation, Gilmore City, Iowa.

Types. State University of Iowa. Holotype No. 2066.

Family BATOCRINIDAE Wachsmuth and Springer

Genus *Eretmocrinus* Lyon and Cass

Eretmocrinus tentor n. sp.

Plate II, Figs. 3-6.

A stout, fairly robust form averaging at least 45 mm. in length from the base to the arm tips. Arms twice the length of calyx. Because of its strong calyx and stout arms this form is often almost perfectly preserved.

Dorsal cup. Sub-oval, height equals width, averages 14 mm. Basal cup shallow, slightly excavated, tending to flare laterally as in a typical *Eretmocrinus*. Interbasal sutures deeply grooved. Radials wider than long, width 6 mm., length 4 mm. Costals two, first quadrangular, second pentagonal, much wider than long. Distichals two, slightly larger than costals, usually hexagonal. Palmars two, except on the postero-lateral rays where on the side nearest the anal interradius only one appears. Brachials of the fourth order appear on the two postero-lateral rays on the side nearest the anal interradius to support the extra arm that usually appears at this position. Anal heptagonal, larger than radials, followed by three plates; from right to left heptagonal, pentagonal, and octagonal. Remaining anal interradius of irregular plates usually 6 or 7 in number. The upper plates of the anal interradius are in contact with the plates of the tegmen. Primary interbrachial large usually 10 sided followed by two plates, occasionally by only one. Interdistichals and interpalmars not present. Surface comparatively smooth, plates slightly raised into low nodes. Occasionally the plates in the upper portion of the dorsal cup are more nodose than those near the base.

Tegmen. Tegmen high, gradually tapering into a long spinose, slightly eccentric, anal tube which in many cases rise more than 10 mm. beyond the arm tips. Spinose radial dome plates appear in groups of three above each ray. Oral plates small, also carrying spines. Arm openings directed laterally causing the arms to flare slightly at their junction with the calyx. Respiratory pores have not been observed.

Arms. Arms biserial, simple, typically 22, four to the ray with the exception of the two postero-lateral rays which carry five each. The extra arm being, in each case, nearest the anal interradius. The number of arms varies, however, from 20 to 23. One form carrying 23 arms has 6 arms in the right postero-lateral ray. Forms having only 21 arms usually carry four instead of five arms on one side of the anal interradius. One specimen bears only 20 arms in which the anterior ray carries only three arms. The arms show a definite transition between typical *Batocrinus* arms and the paddle shaped arms of an *Eretmocrinus*. The bases of the arms are rounded while the upper portions are flattened and definitely much wider. The brachials in the upper portions of the arms give rise to short laterally directed spines about every third to fifth

brachial. The tips of the arms converge inwards around the tube. The pinnulars are of short quadrangular pieces each carrying a short downward directed spine in their central portion.

Column. Columnals averaging 12 to one cm. in the upper portion of the stem and 9 to one cm. in the lower portion. Nodals and internodals alternately arranged throughout the column with every fourth nodal expanded more than the second one. Nodals are much less conspicuous in the lower portion of the column. Stout long cirri characterized by short cirrals are given off at definite intervals from the lower portion of the stem. The lumen is small.

Relationships. A form such as this would be definitely out of place in the earlier Kinderhook strata. The calyx structure resembles very much that of several of the forms of *Eretmocrinus* which are so common in the early Osage formations. Smaller forms of *Batocrinus* had already appeared in the LeGrand beds of the Kinderhook but none of the larger forms with the highly nodose plates were as yet developed. This form marks the first appearance of the genus *Eretmocrinus*. It has not as yet completely developed the features which are so characteristic of the Burlington forms, such as, the eccentric anal tube, the extremely wide paddle shaped arms, and the flaring basal cyclet of plates. The spikes on the upper portion of the arms are developed in exactly the same manner in *Aorocrinus armatus* of the Devonian and in various species of *Dorycrinus* in the Osage.

This is one of the most commonly occurring forms in the fauna. It occurs abundantly in the lower portion of the *Rhodocrinus* zone and has been found in all of the "nests" at Gilmore City.

Occurrence. Gilmore City formation, Gilmore City, Iowa.

Types. State University of Iowa. Holotype No. 2070; paratypes Nos. 2068, 2069, 2071.

Genus *Aorocrinus* Wachsmuth and Springer

Aorocrinus iolu n. sp.

Plate II, Figs. 7-8.

A small species of *Aorocrinus* measuring 52 mm. from the base of the stem to the arm tips. The calyx measures 7 mm. in length and 8 mm. in width. The arms average 9 mm., and are sharply

incurved at the tips. The calyx expands rapidly, and is widest at the arm bases.

Dorsal cup. Basal cup shallow, basals expanded slightly beyond columnals. Radials large, wider than long, width averaging 2 mm. First costal quadrangular, about one-third of the width of the radial, wider than long. Second costal wider than first. Distichals two, approximately the same size as the second costal. Anal inter-radius wide. Anal followed by three plates in second cycle and four plates in the third cycle. Primary interbrachial large, followed by two small plates which rest on an almost horizontal surface.

Tegmen. Shorter than the dorsal cup, plates slightly nodose. Interbrachials connected with tegmen plates. The posterior oral plate is raised into a short spine.

Arms. Arms variable in number, between 20 and 22, the extra arms, if present, being introduced next to the anal interradius. The first four brachials of the arms are stout and uniserial. The change to the biserial structure is made on the fifth brachial. The brachials in the uniserial portion of the arms are very large in comparison to the size of the species. The pinnules are short and stout.

Column. The stem of this form is very distinctive. The columnals immediately below the calyx are sharply expanded, but grade rapidly into rounded forms in the lower portion of the stem. The stem tapers very rapidly. The cirri are long and slender, one being 34 mm. in length. At their point of origin on the stem they are nearly as large as the stem itself.

Relationships. The shape of the calyx and of the stem is very similar to that of *Aorocrinus immaturus* of the LeGrand beds. *A. iola* differs from *A. immaturus* in that there are often 5 arms to each of the postero-lateral rays and also in the fact that the arms change from the uniserial to the biserial structure much sooner on *Aorocrinus immaturus*. The type of arm structure appears to be almost identical with that of *Aorocrinus cauliculus* (Hall) of the Devonian suggesting that this form might have its lineage directly from some Devonian form rather than through *Aorocrinus immaturus*. It may be easily differentiated from any

of the Mississippian species of *Aorocrinus* by this arm structure alone.

This form occurs only sparingly in the fauna. It has been collected from both the *Rhynchopora* zone and the *Rhodocrinus* zone. The greatest number of the forms were taken from very thin blue beds in the *Rhynchopora* zone in the southeast corner of the Pennsylvania Dixie Quarry. Both of the type specimens, however, were taken from "nest" No. two in the *Rhodocrinus* zone.

Occurrence. Gilmore City formation, Gilmore City, Iowa.

Types. State University of Iowa. Holotype No. 2076; paratype No. 2072.

Family ACTINOCRINIDAE (Roemer)

Genus *Cactocrinus* (Wachsmuth and Springer)

Cactocrinus imperator n. sp.

Plate II, Fig. 9; Plate III, Fig. 1.

This is the largest and most robust crinoid that occurs in the fauna. The calyx and arms in the larger specimens often reach a length of 95 mm. The average length of specimens is about 90 mm. The calyx averages about 24 mm. in length and 35 mm. in width at the arm bases. The arms average 55 mm. in length.

Dorsal cup. Basals slightly flaring. Basal cup 3 mm. in height. Radials 6 mm. in height and 7 mm. in width. First costal 4 mm. in height and 5 mm. in width. Second costal slightly smaller. Distichals slightly smaller than second costal. Palmars half the size of the distichal. Interbrachial series normally 12222. Primary interbrachial 6 mm. in width and 6 mm. in length. Anal interradius normally 1244321. Anal plate equal in size to radials. Plates marked with sharp radiating ridges, the lower two cycles usually having from 2 to 3 ridges to each side of the plate.

Tegmen. The disk tapers gradually into a very long slender anal tube which rises at least an inch above the arm tips. The plates of the tegmen are small and usually marked with a low node in their center. Oral plates are small and inconspicuous. The ambulaeral portions of the tegmen have a tendency to be raised.

Arms. Typically 32, all rays carrying 6 except the two postero-lateral rays which carry seven. The extra arm in each case being

nearest the anal interradius. The arms are long, slightly incurving at the tips, and characterized by very small brachials. There are normally about 22 brachials to one cm. The arms average 55 mm. in length and often carry small nodes at regular intervals. The pinnules are characteristic of *Cactocrinus*, having a small spike-like plate on each of the pinnulars.

Column. The stem is stout, consisting of alternately expanded columnals which are thin, usually averaging about 13 to each cm. The lumen is small and round. The edges of the columnals are milled.

Relationships. This form is undoubtedly one of the largest species of the genus *Cactocrinus*. It is equalled in size only by the larger specimens of *Cactocrinus arnoldi* from the LeGrand beds. Several of the lower Burlington species are very nearly as large as this form but none exceed it in size. This form undoubtedly had its origin in the large *Cactocrinus arnoldi* type of the Kinderhook. It differs from *C. arnoldi* mainly in that it has a greater number of arms and its plates are more sharply sculptured. One undescribed form which occurs in the uppermost portion of the LeGrand beds appears to have the same type of ornamentation to its plates.

This species is confined to the *Rhodocrinus* zone and has been found in both quarries at Gilmore City. One large slab upon which are preserved several complete specimens rested in the repository at the University of Iowa for a period of over ten years before the main crinoid horizon was located. This slab was taken from the foundation of a barn which had been built from limestone taken from one of the old quarries in the region.

Occurrence. Gilmore City formation, Gilmore City, Iowa.

Types. State University of Iowa. Holotype No. 2074; paratype No. 2077.

Family HEXACRINIDAE Wachsmuth and Springer

Genus *Dichocrinus* Munster

Dichocrinus bozemanensis (Miller and Gurley)

Plate VI, Figs. 1-2.

1896. *Platycrinus bozemanensis* Miller and Gurley. Illinois State Mus. of Nat. Hist., Bull. 10, p. 83, pl. 5, figs. 16, 17.

A rather large form of *Dichocrinus* measuring 13 mm. from the

base of the calyx to the top of the tegmen. This form differs from most forms of *Dichocrinus* in that the lower portion of the basals is expanded into a flaring rim. The calyx expands rapidly and is 11 mm. wide at the arm bases.

Dorsal cup. Basals two, forming a rather deep cup, the lower portion of which is expanded into a flaring rim which is excavated beneath. Interbasal sutures deeply grooved through this rim. Radials 5 mm. high expanding rapidly, 2 mm. wide at the base and 5 mm. wide at top. Costals two, extremely short, united by syzygy, and occupying less than one-third of the upper face of the radials. The costals in this form are free arm plates. Distichals two or three with apparently no regularity. The anal plate is smaller than the radials and does not expand at the upper portion. Except for a slight protrusion toward the basal eyelet, the anal plate appears as a quadrangular piece.

The plates are marked by low, narrow, roughened, parallel ridges which run both transversely and longitudinally on the radials. The transverse ridges are much better defined near the interradi al sutures. The number of ridges running longitudinally on the radial plates varies from 3 to 6. These ridges are of the same general character as those which are found on *D. cinctus* of the LeGrand beds.

Tegmen. The highly protruding extremely eccentric anal pyramid is the most conspicuous feature of the ventral disk. It appears well down on the posterior side of the disk between the arms and protrudes almost as far laterally as the arms themselves. The plate structure of the protrusion is irregular and is capped by a number of very small pieces. Ambulacral areas raised into ridges and interambulacral areas deeply depressed. The ambulacral ridges converge at very large spinose posterior oral plate which extends well down the posterior side behind the anal protrusion.

Arms. Only a small portion of the arm structure is preserved on the Gilmore City specimens. The arms branch once on the second costal and then again on the second or third distichal, suggesting that the specimen probably has 20 arms. There are not enough brachials above the last bifercation to determine if the arms are uniserial or biserial. Pinnules consisting of short quadrangular pieces are preserved on two of these lower brachials.

Column. The stem of this form has not been observed on the Gilmore City form.

Relationships. In 1896, Miller and Gurley¹³ described this species from the Madison limestone of Montana as *Platycrinus douglassi*. This specimen is not figured by Wachsmuth and Springer in their report on North American Camerate Crinoids because at the time the specimen was unavailable for study. The type specimen is now in the collection of the University of Cincinnati. The species was described from a single specimen which is preserved on a slab so that only the anterior side is exposed. A comparison of the Madison form with the Gilmore City form has shown them to be identical. The occurrence of such a peculiar species of *Dichocrinus* in two widely separated formations should be of considerable significance when their relative ages are considered.

This form may be easily recognized from all other species of *Dichocrinus* by its flaring base, its rapidly expanding calyx, its peculiar plate markings and its highly protruding anal pyramid.

This species of *Dichocrinus* might very easily have been derived from the Kinderhook species *Dichocrinus cinctus*. It is quite definitely different but shows relationships in the type of plate markings. This particular group of striated species of the genus *Dichocrinus* also have descendants in the Burlington in the form of *D. striatus*.

Only two specimens of this form have been found at Gilmore City. They were found together on a slab lying in the bottom of the Pennsylvania Dixie Quarry. Because of this, the horizon from which they came can not be determined with absolute certainty. The character of the slab, however, suggests the thin beds that mark the base of the *Rhodocrinus* zone near the southeast side of the quarry.

Occurrence. Gilmore City formation, Gilmore City, Iowa.

Figured specimen. State University of Iowa. No. 2073.

Dichocrinus multiplex n. sp.

Plate IV, Fig. 1

A large species of *Dichocrinus*. Calyx averaging 12 mm. in length and 10 mm. in width. Stem fully 120 mm. in length, the

¹³ Miller, S. A., and Gurley, W. F., Illinois State Mus. of Nat. Hist., Bull. 10, p. 83, Pl. 5, Figs. 16-17, 1896.

lower portion of which is crowded with long slender cirri. Arms averaging 38 mm. in length.

Dorsal cup. Basals forming a cone shaped cup, expanding gradually until the full width of the calyx is reached at their tops. The height of the basals being 5 mm. Basal suture not sharply defined. Radials twice as long as wide, arm facet occupying about one-third of their upper surfaces. Anal side bulging. Anal plate much wider at the base than at the top.

Tegmen. Consisting of very small plates. Ambulacral plates sharply defined, running in a continuous raised series from the arms to the center of the disk. Oral plates slightly larger than others of the disk. The anus is eccentric and situated on a slight protuberance above the anal interradius. Interambulacral plates situated in depressions between the raised ambulacral rays.

Arms. Slender, uniserial, brachials very short in comparison to their width, cuneiform in the upper portion of the arms and averaging five to 1 mm. Pinnules slender, closely packed together, consisting of from 10 to 18 pieces. The bases on which the pinnules rest protrude beyond the general ventral surface of the arms. Since the pinnules arise from every segment from alternate sides of the arms the raised pinnule bases give the ventral surface of the arm a saw tooth appearance. Arms flare laterally at about their mid length and taper to very fine delicate ends. The tips are incurved. The arms branch once on the second costal making 10 arms to each specimen.

Stem. Long slender, sharply differentiated into sharp nodals near the proximal end. Columnals thinner just below calyx and every other segment expanded. This character soon changes and every fourth segment is expanded into a nodal. The nodals become much less prominent towards the distal end of the stem. The lower third of the stem gives rise to a great number of slender curling cirri, many of which measure 30 mm. in length.

The calyx plates are smooth and without markings of any kind.

Relationships. This form is undoubtedly derived from the *D. inornatus* type of erinoid which occurs so abundantly in the Kinderhook at LeGrand. It differs from *D. inornatus* in that it is usually smaller in size, the basal cup does not expand as rapidly and the length of the calyx in proportion to the width is greater than in

D. inornatus. The pinnules and arms are much less coarse and much more delicate on this form. This form compares most closely with that of *Dichocrinus delicatus* of the LeGrand beds. It differs again in the elongation of the base and in the fact that *D. delicatus* has biserial arms.

This form occurs abundantly in both the *Rhynchopora* and *Rhodocrinus* zones of the quarries at Gilmore City. One horizon located near the very upper portion of the *Rhodocrinus* zone is particularly rich in these forms. There are several layers on the west side of the Pennsylvania Dixie Quarry near the north end that are usually well covered with specimens of this form. This particular species because of its delicate arms and pinnules is usually very much broken and fragmented.

Occurrence. Gilmore City formation, Gilmore City, Iowa.

Types. State University of Iowa. Holotype No. 2075.

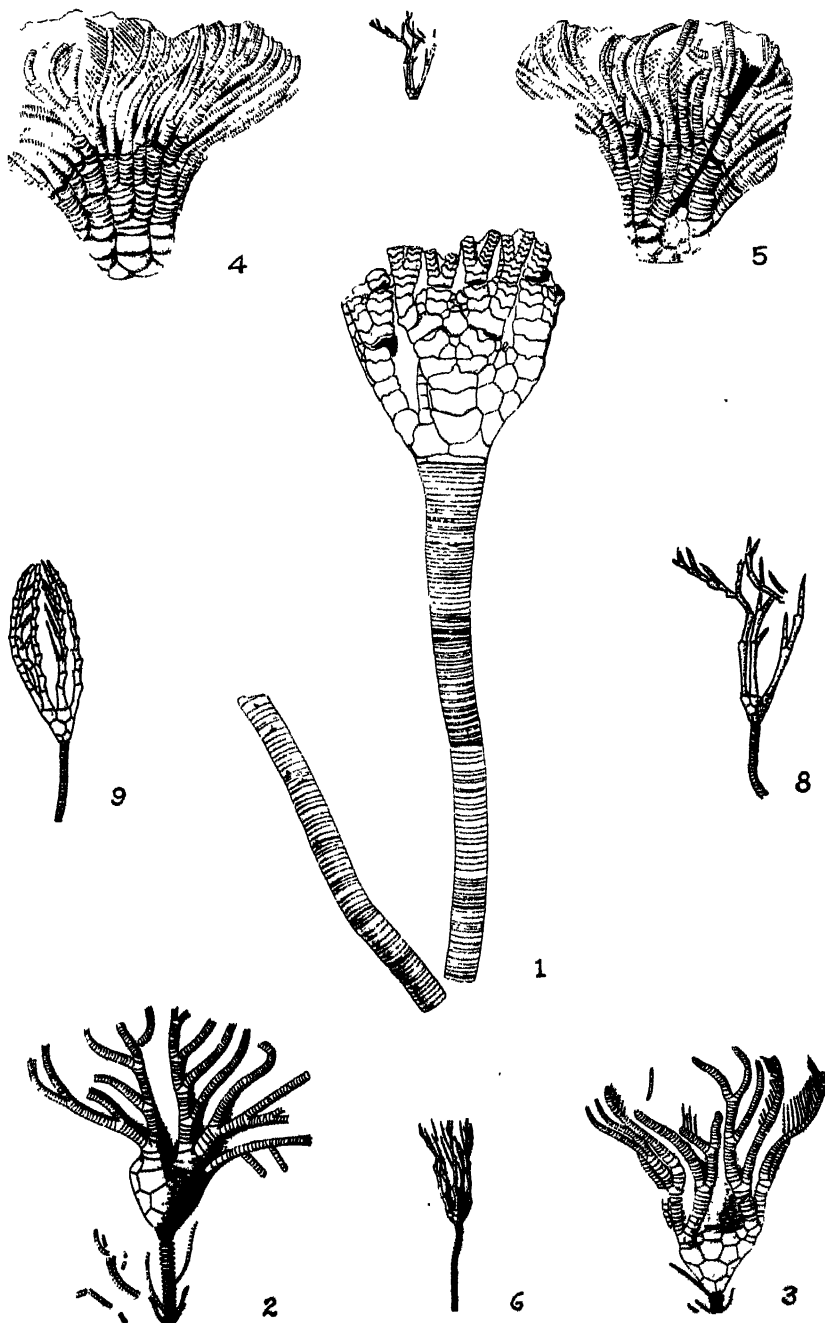
Dichocrinus campto n. sp.

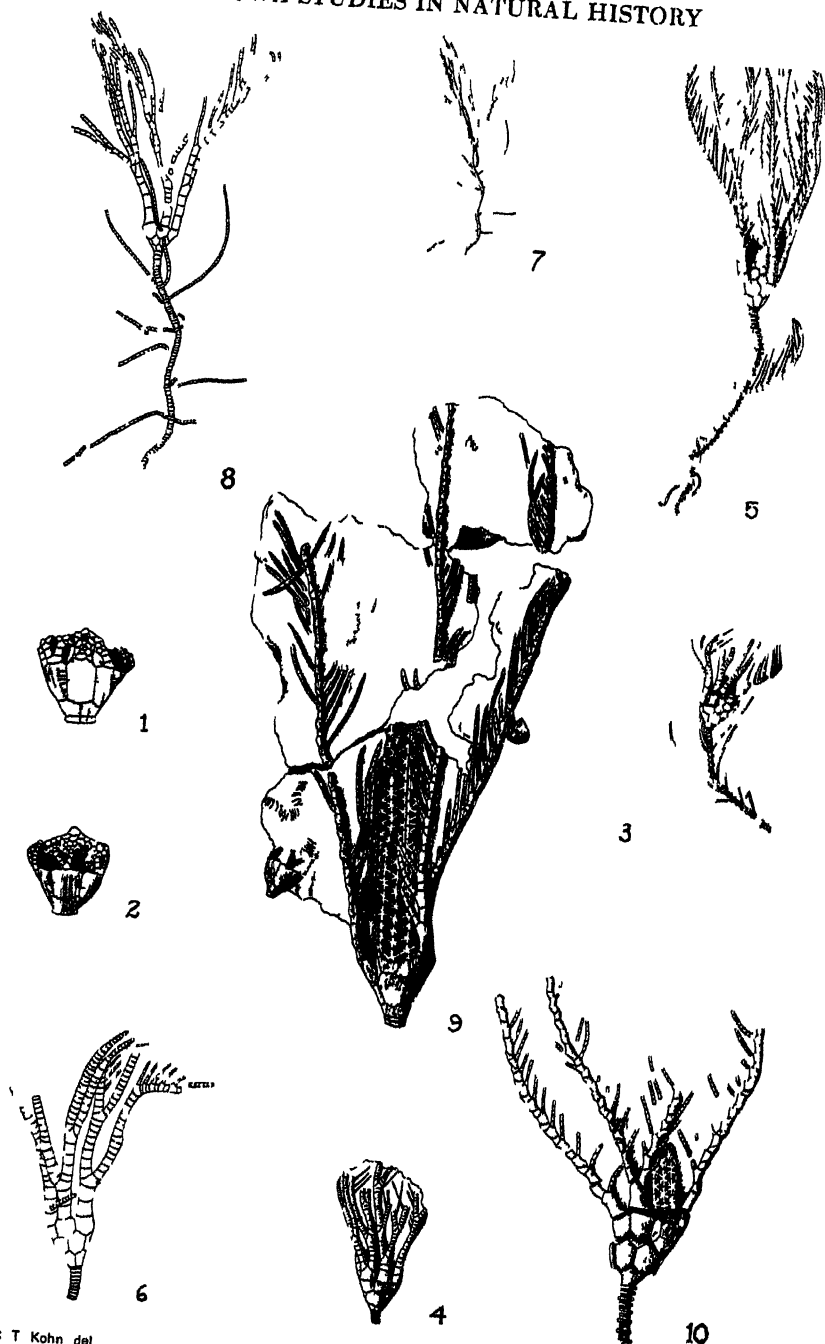
Plate II, Fig. 10; Plate VII, Figs. 1-2

This is the smallest and most delicate form of crinoid occurring in the entire fauna. The largest specimens will measure about 20 mm. from the base of the calyx to the arm tips. The average sized

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Fig. 1. <i>Eutaxocrinus dero</i> n. sp.	58
Posterior view of the holotype. The length of the arms being nearly twice the length of the calyx as shown in this specimen. x 1.	
Figs. 2,3. <i>Pachylocrinus fimbria</i> n. sp.	64
2. Posterior view of the holotype showing the unilateral heterotomous type of arm branching. x 1.	
3. Anterior view of a paratype. x 1.	
Figs. 4,5. <i>Zeacrinus compactus</i> n. sp.	66
4. Anterior view of the holotype. x 1.	
5. Posterior view of the same specimen. x 1.	
Fig. 6. <i>Decadocrinus douglassi</i> (Miller and Gurley)	68
Posterior view of a typical specimen. x 1.	
Figs. 7-9. <i>Gilmocrinus iowensis</i> n. gen. and sp.	71
7. Anterior view of a very immature specimen showing the exceptional length of brachials in comparison to the calyx in early stages of development. x 1.	
8. The same specimen enlarged. x 2.	
9. Lateral view of a slightly larger specimen showing two arms in one of the rays. x 1.	





specimens average 12 mm. from the base to the tips of the arms. A few complete specimens are now in the collection which measure less than 8 mm. from the base to the arm tips. The calyx occupies one-fourth of the length from the base to the arm tips. The width of the calyx varies with the size of the specimen from one and one-half mm. to 5 mm. The stem is slender, delicate, and reaches a length of 50 mm.

Dorsal cup. Basal cup shallow, expanding very rapidly, inter-basal suture not sharply defined. Radials low, slightly convex, only slightly longer than wide. The arm facets occupy about one-third of the upper surface of the radials. The anal is slightly broader at the base than at the top.

Tegmen. The ventral disk has not been observed.

Arms. Arms biserial, three times as long as calyx, and characterized in general by their exceptionally coarse pinnules which are heavy and short. The brachials are large and coarse.

Column. The stem is sinuous, suggesting the possibility of coiling. It consists of regular columnals without marked differentiation into expanded nodals. At regular intervals long slender cirri

EXPLANATION OF PLATE VI

	Page
Figs. 1,2. <i>Dichocrinus bozemanensis</i> (Miller and Gurley)	52
1. Posterior view of a specimen showing the flaring base, the rapidly expanding calyx, and the radiating plate markings. x 1.	
2. Anterior view of the same specimen. x 1.	
Figs. 3,4. <i>Pachylocrinus crinitus</i> n. sp.	63
3. Posterior view of the holotype showing the stem and cirri. x 1.	
4. Anterior view of a paratype. x 1.	
Figs. 5,6. <i>Gulmicrinus thomasi</i> n. sp.	67
5. Posterior view of the holotype. x 1.	
6. Lateral view of a paratype. x 1.	
Figs. 7,8. <i>Lasiocrinus expressus</i> n. sp.	60
7. Anterior view of the holotype. x 1.	
8. The same specimen enlarged x 2 showing the type of arm branching.	
Figs. 9,10. <i>Gilmocrinus iowensis</i> n. gen. and sp.	71
9. Posterior view of the genotype showing the long unbranched arms. x 1.	
10. Posterior view of a paratype in which the left postero-lateral arm branches once. x 1.	

are given off throughout the entire length. Apparently at least four such cirri are given off at each of these intervals on the stem.

The plates of the calyx are without ornamentation of any kind.

Relationships. The genus *Camptocrinus* is identical with *Dichocrinus* except for the coiled stem and the whorls of cirri that are given off at intervals along the stem. The calyx and arms of *Camptocrinus* exhibit the same shallow cup and coarse arm structure that is characteristic of this species. This form is without doubt an early form transitional from the genus *Dichocrinus* to the genus *Camptocrinus* which appears later in the Mississippian. The only essential differences between this form and a true *Camptocrinus* is that the stem of this individual does not coil and the cirri do not come off in such dense whorls from the nodals of the stem. The cirri are not confined to one side of the stem as they are in a typical *Camptocrinus*.

This form occurs quite abundantly in both the *Rhynchopora* and *Rhodocrinus* zones. It is far more abundant, however, in the *Rhodocrinus* zone. The holotype, which shows the stem so well, was taken from thin-bedded oölitic limestone in the upper portion of the *Rhynchopora* zone.

Occurrence. Gilmore City formation, Gilmore City, Iowa.

Types. State University of Iowa. Holotype No. 2079; paratype No. 2078.

Order FLEXIBILIA Zittel

Family TAXOCRINIDAE Wachsmuth and Springer

Genus *Eutarocrinus* Springer

Eutarocrinus dero n. sp.

Plate II, Fig. 11, Plate V, Fig. 1

Closely resembling *E. fletcheri* of the LeGrand beds but considerably larger in size, with much better developed interbrachial plates. Calyx and arms averaging 65 mm. in length, width at widest portion about 36 mm. The upper portions of the arms are very long and slender.

Calyx and Arms. Infrabasals small, low, very inconspicuous, less than one half mm. in height. The lower surface in contact with the stem is milled. Basals low, 9 mm. in width, 5 mm. in height at the point which projects between radials. The posterior basal is considerably larger and projects into the anal interradius. Radials larger than basals, heptagonal expanding toward their up-

per portions; width at maximum 12 mm., height 3 mm. at center. Costals two equal in size, width 7 mm., height 3 mm. Distichals three slightly smaller than costals, width 6mm., height 3 mm. Palmars from three as a minimum to six as maximum. Interbrachial plates strongly developed with a normal sequence 123 followed by smaller plates. One ray shows 133 plates followed by a series of smaller plates. The primary interbrachial is about equal in size to the first costal and the two following plates are about half its size. Interdistichal areas are also well developed normally carrying two plates. The right postero-lateral ray of the holotype carries at least 8 plates one of which is quite large. The anal consists of a single series of plates. Radial in upper oblique position, small, resting on truncated face of radial, in contact with first anal plate and first costal. Arms dichotomous, branching four or five times. The upper portions of the arms are very slender and small. The ventral disk has not been observed. The ambulacrals consist of a double row of imbricating overlapping plates. They are bordered on either side by alternate spinose portions of the brachials.

Column. Expanded abruptly near its upper portion. Columnals very thin, 16 occurring in one cm. near upper portion of stem. Columnals of varying thickness throughout stem. Slightly thicker in lower portion of stem. Lumen pentagonal, small.

Relationships. This form appears to be most closely related to *E. fletcheri* of the Kinderhook formation at LeGrand. On a whole it is much larger, its interbrachial plates are more abundant and larger. It expands more rapidly, the anal interradius is wider, and its stem lacks the typical nodose expanded columnals of *E. fletcheri*. This form represents one of the latest occurrences of the genus *Eutaxocrinus* since it is typically a Devonian genus.

It occurs only rarely in the fauna and has been found only in the *Rhodocrinus* zone. Only three specimens have been collected at the present and all of these come from the "nests" of the Pennsylvania Dixie Quarry at Gilmore City.

Occurrence. Gilmore City formation, Gilmore City, Iowa.

Types. State University of Iowa. Holotype No. 2080.

Order INADUNATA Wachsmuth and Springer

Suborder FISTULATA Wachsmuth and Springer

Family CYATHOCRINIDAE (Roemer)

Genus *Lasiocrinus* Kirk

Lasiocrinus expressus n. sp.

Plate VI, Fig. 7-8

This species is known only from a single very delicate specimen. The genus *Lasiocrinus* is not typically a Mississippian genus and although the characters of this form can not be fully determined it seems that it can be referred to no other genus. The length of the holotype is only 28 mm. including the stem. The calyx and arms are only 15 mm. in length.

Dorsal cup. The plates of the dorsal cup can not be fully studied without approaching the specimen from the under side, since it is preserved on a slab of the limestone. There is apparently no change in the structure of the anterior ray since three almost identical rays are in view and the anal interradius is not exposed. The calyx is short, expanding very rapidly, slightly over 1 mm. in height, and a little over 2.5 mm. in width. The infrabasals are small. The basals are smaller than the radials and are widest at their upper ends. The radials are considerably wider than high. The sutures between plates are depressed.

Ventral sac. The anal sac is not exposed but is apparently quite short.

Arms. The structure of the arms suggests that this form should be referred to the genus *Lasiocrinus*. The arm structure is very similar to that of *L. Scoparius* (Hall) from the Devonian. Arms delicate uniserial, branching for the first time on the fourth or fifth brachial. They have a bilaterally ~~harm.~~ symmetrical structure after the first branching. The branch in ~~epor~~eporthe is smaller than the main trunk of the arm. They branch at more frequent intervals near their distal ends than at the proximal end. The pinnules, if present, have not been observed.

Column. The column is definitely pentagonal throughout its exposed length. Only 14 mm. of the stem is preserved. Each columnal of the stem is expanded into a low node at each of the corners. Long delicate cirri are given off at regular intervals throughout the

length of the stem. The columnals from which the cirri arise are definitely expanded and of larger size. Four whorls of cirri are given off in the 14 mm. of stem that is preserved on the holotype.

Relationships. While *Lasiocrinus* is not a widely distributed genus nor typically Mississippian; the non-pinnulate arms, the pentagonal stem, the bilaterally heterotomous type of arm branching, and the rapidly expanding calyx all suggest that it is to be correctly classified with this genus. It may be differentiated from the New York forms by the cirri on the stem and by its delicate nature. Later work in the area may yield better specimens for study.

Occurrence. Gilmore City formation, Gilmore City, Iowa.

Type. State University of Iowa. Holotype No. 2093.

Family GLOSSOCRINIDAE Goldring

Genus *Goniocrinus* S. A. Miller

Goniocrinus maximus n. sp.

Plate VII, Fig. 8

This species represents the second known occurrence of this genus in North America. It is similar in many respects to the form described from the LeGrand beds at the time the genus was erected. Almost all of the characters of the original form are reflected in this new species.

Since this form is known from only one broken specimen, it is not possible to give complete measurements. It appears that a portion of the central part of this specimen has been lost. The specimen was at least 60 mm. in length from the base of the cup to the arm tips.

Dorsal cup. The lower portion of the dorsal cup of this specimen, including infrabasals and lower portion of the basals, is missing. The radials and the upper portion of the basals are preserved. The calyx appears to be conical in shape and is probably not over $3\frac{1}{2}$ mm. in height. It measures 5 mm. in width at the arm bases. The radials are considerably wider than long and their upper faces are quite concave. The anal plate is small, quadrangular, and is located quite differently than that of any other members of the Glossocrinidae. It was probably because of the position of the

radial plate that this genus has been referred to the cyathocrinidae. The radial plate is in contact with the anal and the right postero-lateral radial above and with two basal plates below. The anal plate is in contact laterally with two radial plates, with the posterior basal and the radial beneath, and with the middle primary tube plate above.

All plates of the dorsal cup are nodose and roughened.

Ventral sac. The anal sac is long and tapering reaching the entire length of the arms. The posterior side is marked by a median row of heavy pieces that strongly resembles an extra arm. The presence of this median row of plates on the anal side is of important taxonomic significance. The remaining plates of the sac are small and exceptionally irregular. It is very difficult to locate interplate sutures in the tube since the surface is covered with small irregular spines. The median row of plates on the posterior side of the anal articulates directly upon the anal plate and is not offset to the right as is usual in Devonian members of the Glossoocrinidae. In many of the Devonian forms the central primary tube plate is in contact with both the radial and the anal plates thereby separating the anal plate from the right postero-lateral radial. The anal opening has not been observed.

Arms. The arms of this form are very similar to those of the LeGrand form. They branch once on the fourth brachial instead of on the third brachial as in *G. sculptilis*. They give rise to long, strong, ramules from every other brachial. The arrangement of these ramules on every fourth brachial gives the arm the appearance of having a bilaterally heterotomous structure.

Stem. The stem has not been observed. Although the stem of this form has not been seen, it may be inferred that it will be pentagonal. This form closely parallels the LeGrand form in all other ways and will undoubtedly also have a pentagonal stem. This stem was covered with exceptionally long whorls of cirri probably throughout its entire length. These cirri are undoubtedly longer and stronger than those of the typical LeGrand form. Although the stem is missing, a group of six of these cirri have been preserved with the specimen and measure at least 17 mm. in length. The entire length of them was undoubtedly much greater.

Relationships. This form has been classified with the Cyatho-

erinidae because of the position of the anal and radianal plates and because of the structure of the arms. The genus is considered as belonging to the family Glossoeriniidae by the writer because of the following reasons. The type and structure of the anal tube in Inadunate erinoids is always highly diagnostic. The long tube with the median row of plates is sufficiently different from other groups of Inadunate erinoids to place the form in the Glossoeriniidae. The only modification which has been necessary to produce the *Goniocrinus* calyx structure from that of the typical *Glossocrinus* structure is a shifting of the radial plate over against the anal plate thereby enclosing the radianal within the calyx. The position of this radianal plate would suggest immediately that the form belonged to the Cyathoeriniidae. However, when all of the characteristics of the form are considered, such as the long primitive tube with the median row of plates, the slender arms with elongated brachials which give rise to long ramules it would appear that this form had definitely been derived through a differentiation of some form of the family Glossoeriniidae.

Occurrence. Gilmore City formation, Gilmore City, Iowa.

Types. State University of Iowa. Holotype No. 2094.

Family POTERIOCRINIDAE Springer

Genus *Pachylocrinus* Wachsmuth and Springer

Pachylocrinus cirrifer n. sp.

Plate VI, Figs. 3-4

A small rather delicate form averaging between 15 and 18 mm. in length from the base of the calyx to the tips of the arms. The calyx averages between 3 and 5 mm. in length and is as wide as it is high. The stem is characterized by an abundance of cirri which are given off throughout its length.

Dorsal Cup. Cone shaped, expanding quite rapidly, having a typical *Pachylocrinus* structure. Infrabasals short, wider than long. Basals comparatively large averaging 2 mm. in length. Radials short, width about twice length. Radianal pentagonal almost as large as the anal. No plate decorations.

Ventral sac. Not observed but definitely not as long as the arms.

Arms. Imperfect unilateral heterotomy, branching once on the

first brachial except in the anterior ray where the first branching occurs on the fourth brachial. Branching three times all together. Brachials of the second order varying from 6 to 8 and brachials of the third order from 8 to 13. Axillary brachials considerably larger than others. Slightly cuneiform pieces developed only in the upper portions of the arms. Pinnules rather short and stout.

Column. Nodals and internodals alternately spaced in upper portion of stem. Columnals much longer in lower portion of stem and nodals appear on every fourth columnal. The outstanding feature of the stem is found in the long cirri which are given off throughout the length of the column. Many of these cirri are over 22 mm. in length.

Relationships. The two forms of the *Pachylocrinus* in this fauna exhibit to a marked extent the variations in the arm structure within this genus. As usually defined the arm structure must be dichotomous, although many of the forms have a marked tendency for unilateral heterotomy. The arms of this form are rounded and definitely not abutting but their method of branching is imperfect unilateral heterotomy.

This is not an abundantly occurring form in the fauna. About 10 specimens are all that have been obtained as yet. It apparently is found much more extensively near the very base of the *Rhodocrinus* zone than in any other part of the formation.

Occurrence. Gilmore City formation, Gilmore City, Iowa.

Types. State University of Iowa. Holotype, 2082; paratype, 2081.

Pachylocrinus fimbria n. sp.

Plate V, Figs. 2-3

A large robust form of *Pachylocrinus* with stout arms, a rapidly expanding calyx, and a stem covered with cirri, throughout its length. The height of a specimen showing calyx and arms is 27 mm. The calyx averages 10 mm. in width at its junction with the arms.

Dorsal cup. Cup as in other forms of *Pachylocrinus*. Infra-basals comparatively large, forming a considerable portion of the dorsal cup. Basals large averaging 4 mm. in width, and 3 mm. in

height. Radials considerably wider than high. Radial nearly as large as anal.

Ventral sac. Only two specimens of this form have been collected and the tube is not exposed in either specimen.

Arms. Arms rounded, not abutting, branching once on the first brachial, exhibiting perfect unilateral heterotomy in their manner of branching. The second branch occurs on the 8th brachial, the third on the 15th brachial, the fourth on the 25th brachial, and the fifth on the 37th brachial on the left side of the anterior ray. The branching is somewhat less often in the other rays. The brachials are not markedly cuneiform. The pinnules are stout and rather short.

Column. Only the upper portion of the stem has been observed. It consists of alternately expanded nodals and gives rise to whorls of cirri at intervals starting almost immediately below the calyx. These cirri extend upwards beyond the dorsal cup in some cases.

Relationships. This form with its unilaterally heterotomous arms can not be correctly classified as *Pachylocrinus* under the present definition of that genus. All of the characteristics of the genus *Pachylocrinus* are answered by this form except the manner of branching of the arms. Springer¹⁴ includes forms having one or two unequal arms which branch on the inside of the ray in this genus. "Although having typically dichotomous arms, it will include some forms in which there are one or two arms branching unequally on the inner side of the ray, provided these arms are rounded and not abutting as in *Zeacrinus*."

It would appear then that the genus *Pachylocrinus* might better be defined as having both dichotomous and heterotomous arm structure. The arms should branch on or before the second brachial, should branch more than once, and should be rounded and not abutting. *Pachylocrinus arboreus* of the Chester from Huntsville, Alabama, has exactly the same type of arm structure that is exhibited in this form.

The form does not occur abundantly and has been found only in the very basal beds of the *Rhodocrinus* zone. Both specimens were

¹⁴ Springer, F., Unusual Fossil Crinoids, Proc. United States Nat. Mus., vol. 67, Art. 9, p. 70, 1926.

isolated and had no relation to the "nests" of erinoids in the region.

Occurrence. Gilmore City formation, Gilmore City, Iowa.

Types. State University of Iowa. Holotype No. 2083; paratype No. 2084.

Genus *Zeacrinus* Hall

Zeacrinus compactus n. sp.

Plate V, Figs. 4-5

This form exhibits all of the common characters of the genus *Zeacrinus* and is a very early occurrence of this genus. It is characterized by rugged decorated plate structure and spinose nodose projections on the axillary pieces in the arms. The holotype is 37 mm. in height from the base to the arm tips. The arms flare considerably in their upper portion and are incurved at their tips.

Dorsal cup. Base flattened. Infrabasals hidden at bottom of a wide basal concavity. Basals inflated into nodes which project laterally. Radials very low and angular, width 5 mm. height 2 mm. The upper face being somewhat concave. The radianal plate is as large as the radial and is in a normal position in contact with two basals beneath, with the right radial and anal laterally, and the right primary tube plate above. In no place does it come in contact with the right costal. The anal is in contact with the left postero-lateral costal and left radial with the radianal and right primary tube plate, with the central and left primary tube plates above, and with the posterior basal beneath. Plates of the anal interradius are very rough and nodose.

Ventral sac. The sac is not visible in specimens which have been collected so far.

Arms. The arms exhibit perfect unilateral heterotomy throughout. The first costal is axillary and is much larger than either the basal or radial plates; being 5 mm. in width and 3 mm. in height and sharply nodose. The arms branch 7 times at a maximum with the exception of the anterior ray. In the left postero-lateral ray the branching takes place on the following brachials 1, 7, 13, 21, 31, 38; on the right postero-lateral ray 1, 7, 13, 20, 28, 38; on the left antero-lateral ray 1, 7, 13, 20, 28, 36, 47; on the anterior ray 3, 9, 17, 25, 37, 56, and on the right anterior-lateral ray 1, 8, 14, 20, 28.

and 37. The brachials tend to be more cuneiform in the upper portions of the arms than is usually characteristic of the genus *Zea-crinus*. The pinnules are short and closely set together.

Column. The stem is round consists of alternate sharply expanded brachials. It tapers quite rapidly and apparently is not a long stem. Only the upper portion has been observed.

Relationships. This form is structurally very much like other forms of the genus that occur in the lower portion of the Mississippian. It differs from all others however in its exceptionally rough nodose plate markings. The anal area has not been greatly modified as yet from that of the usual number of the *Poteroocrinidae*.

The form does not occur abundantly in the fauna. Three specimens have been collected to date. All three were found during the last field season in the region, in "nest" No. one of the Pennsylvania Dixie Quarry.

Occurrence. Gilmore City formation, Gilmore City, Iowa.

Types. State University of Iowa. Holotype No. 2085.

Genus *Culmicrinus* Jackel
Culmicrinus thomasi n. sp.

Plate VI, Figs. 5-6

This form averages somewhat smaller than the commonly occurring forms of *Culmicrinus* from the St. Louis formation. The length of the calyx and arms of typical specimens is about 32 mm. The calyx is cone shaped, 5 mm. wide at arm bases and 5 mm. high. The arms and pinnules are delicate.

Dorsal cup. The structure of the dorsal cup is very definitely that of the common member of the *Poteroocrinidae*. Infrabasals comparatively large. Basals a little higher than wide. Radials are slightly smaller than basals and about as high as wide. Radial anal nearly as large as anal and its upper face is about at the mid-point on the side of the radial.

Ventral sac. The sac is long reaching nearly the full length of the arms. The plates are mainly hexagonal with sharp radiating decorations running from the center of each plate to the center of each side of the plate. The anal opening is low, directly behind the anterior ray. The upper end of the tube is spinose.

Arms. The arms are uniserial, dichotomous, and branch only twice, once on the fifth brachial and once on the twelfth brachial. The brachials are markedly cuneiform and give rise to comparatively slender long pinnules. The length of the arms on the holotype is about 28 mm. The anterior ray varies slightly in that it branches first on the 8th brachial instead of the fifth and apparently branches only once.

Column. The stem is round and consists of alternately expanded columnals. It is comparatively slender for the size of the calyx. The cirri are small, delicate, and not numerous.

Relationships. This form is apparently one of the rather primitive forms of this genus. The forms described by Goldring¹⁵ as *Liparocrinus* are not to be referred to this genus nor are they closely related to this form. In the report by Springer¹⁶ *Liparocrinus* is considered as a synonym for *Culmicrinus*. The genus *Culmicrinus* has apparently had its origin directly from one of the larger forms of *Pachylocrinus*. The structure of the tube and of the anal interradius is much more closely related to the *Pachylocrinus* than it is to any of the Glossoocrinidae. This form may be distinguished from the described forms of *Culmicrinus* by the fact that the arms branch on the fifth brachial rather than on later ones and by the general delicate nature of the species in comparison to others.

This form occurs very abundantly in the fauna and has been found in all three of the "nests" in the Pennsylvania Dixie Quarry at Gilmore City.

Occurrence. Gilmore City formation, Gilmore City, Iowa.

Types. State University of Iowa. Holotype No. 2086; paratype No. 2053.

Genus *Decadocrinus* Wachsmuth and Springer
Decadocrinus douglassi (Miller and Gurley)

Plate V, Fig. 6, Plate VII, Fig. 7.

1896. *Poteriocrinus douglassi* Miller and Gurley, Illinois State Museum of Nat. Hist., Bull. 10, p. 83, pl. V.

This form is one of the smaller crinoids of the fauna. Several

¹⁵ Goldring, Winifred, Devonian Crinoids of New York: New York State Mus. Mem., No. 16, p. 397, 1923.

¹⁶ Springer, Frank, Unusual Fossil Crinoids: Proc. United States Nat. Mus., vol. 67, Art. 9, p. 1-137, pl. 1-26, 1926.

specimens have been obtained which show almost the complete form including the exceptionally long delicate stem. The maximum length of the calyx and arms is about 15 mm. On smaller forms the calyx and arms are less than 8 mm. in length. One form in which the calyx and arms are 15 mm. in length has a stem which measures 55 mm. in length.

Dorsal cup. The dorsal cup expands rapidly making a shallow conical cup. The infrabasals are small and make up only a small portion of the cup. The basals are smaller than the radials and definitely much wider on the top than on the bottom. The radials tend to be considerably wider than long. The posterior basal is considerably larger than the others and supports comparatively small radial and anal plates. The structure of the anal inter radius is similar to all members of the *Poteroeriniidae*.

Ventral sac. The ventral sac is not well preserved in any of the specimens. It is considerably shorter than the arms and consists of alternately placed hexagonal plates. The anal opening has not been observed. The summit of the sac is ornamented with two small sharp spines.

Arms. The species carries 10 arms, the branching of which takes place on the first brachial. This first brachial occupies only a portion of the upper face of the radial and is usually nearly 2 mm. in length in larger forms. It is constricted at its mid-length and flares most at its junction with the radial. The brachials are long and all somewhat constricted at their mid-lengths. The sutures between the brachials are such that the arms have the appearance of being sinuous. Each brachial gives rise to a long strong ramule from alternate sides of the arm. The number of brachials in large specimens is not over twelve.

Column. The stem is slender and long, although the distal end is quite minute. It tapers slowly. Columnals are close together immediately below the calyx but are nearly as long as wide in the lower portion of the stem. Every fourth or fifth columnal is greatly expanded in the lower portion of the stem. Cirri have not been observed.

Relationships. The genus *Decadocrinus* is an old long ranging genus. This form differs from most Devonian forms in that the arms branch for the first time on the first brachial rather than on

the second. This form is identical, with the form described from the Madison limestone, in structure and general appearance. The Madison form appears in general to be considerably larger. This form was undoubtedly in the line of ancestry to the large number of forms of this general type that appear later in the Mississippian. *D. ulrichi* of the Keokuk is very similar in structure to this species.

This form has been found only in the thin bedded limestones that make up the upper portion of the *Rhynchopora* zone in the south end of the Pennsylvania Dixie Quarry. It may have a larger range but as yet specimens have all been confined to this horizon.

Occurrence. Gilmore City formation, Gilmore City, Iowa.

Figured specimen. State University of Iowa. No. 2095.

Gilmocrinus n. gen.

Genotype: *Gilmocrinus iowensis* n. sp.

The genus *Gilmocrinus* is erected to care for crinoids belonging to the Poteriocrinidae; which carry either five or six arms to the specimen. All other genera in this family bear at least 10 arms. The five armed form is more common in the Gilmore City fauna.

These forms have all of the typical calyx and anal structure of the Poteriocrinidae. The radianal is in contact laterally on one side with the radial and basal, on the other with the anal and posterior basal, and above with the left primary tube plate. The basals are hexagonal, except for the posterior and the right postero-lateral, which are heptagonal. The anus opens low on the anterior side much as in *Culmicrinus*. The plates of the ventral sac are ornamented with raised radiating ridges. The summit of the sac carries several spinose plates.

Arms exceptionally long in adult specimens and comparatively short in immature specimens. Immature specimens characterized by an exceptionally long first brachial. Arms uniserial, brachials exceptionally cuneiform. Stout pinnules are given off from each brachial. The arms are usually single but occasional specimens have a single arm branching once on the first brachial. There is apparently no regularity as to which arm branches.

A specimen belonging to this genus was described by Miller and Gurley¹⁷ from the Madison limestone of Montana as *Poteriocrinus*

¹⁷ Miller and Gurley, Illinois State Mus. of Nat. Hist., Bull. 10, p. 82, 1896.

bozemanensis. The type specimen has been restudied by the writer and it seems certain that it belongs to this genus.

Gilmocrinus iowensis n. sp.

Plate V, Figs. 7-9, Plate VI, Figs. 9-10, Plate VII, Figs. 3-6

Since this is one of the abundantly occurring species in the Gilmore City formation, specimens have been obtained ranging from large adult forms to very immature forms. The length of the calyx in the larger forms averages 10 mm. and the width is usually around 9 mm. The arms are exceptionally long in the adult specimens and comparatively short in the young forms. The length of the arms in the holotype is 74 mm. and their upper portions are broken off. One exceptionally large specimen shows an arm length of over 90 mm.

Dorsal cup. Cone shaped. Infrabasals comparatively large, making a considerable portion of the dorsal cup. Basals slightly wider at top, 4 mm. in width and 4 mm. in height, hexagonal except the posterior and the right postero-lateral which are heptagonal. Radials much wider than high, 4 mm. in width and 2 mm. in height. Posterior basal slightly larger than others. Radial plate pentagonal, smaller than anal; in contact on the right with the right postero-lateral basal and radial, on the left with the posterior basal and anal plate, and above with the right primary tube plate. The anal plate projects slightly above the line of contact of the radial with the first brachial of the arm.

Ventral sac. Very long, reaching nearly to the full length of the arms in adult specimens. Considerably shorter than arms in immature forms. Consisting of rows of hexagonal plates marked with radiating raised ridges which radiate from the center of each plate to each of the sides. The upper end of the sac is ornamented by two or three sharp spines. The anal opening is very low and directly behind the anterior ray very much as in *Culmicrinus*.

Arms. The arms of this form are very distinctive. The proximal brachial is longer than any of the others and the brachials become progressively shorter towards the distal end of the arm. In immature specimens the first brachial is exceptionally long apparently reaching its full length almost immediately. The brachials throughout the arms are exceptionally cuneiform but at no place in the arm are they crowded closely together. Stout pinnules are given off

from alternate brachials beginning with the first brachial. On some specimens the arms are single throughout the entire five rays. On others, one may branch making a six armed specimen. The six armed specimens are less common than the five armed forms. There is apparently no regularity as to which of the arms shall branch. On one form the right postero-lateral ray bears two arms. Another specimen shows the left antero-lateral ray bearing two arms. The arms branch on the first brachial whenever they branch showing their relation to *Decadocrinus*.

Column. The stem is round, with very little differentiation in the way of alternately expanded columnals. One of the smaller specimens appears to carry long cirri near its lower portion.

Relationships. Crinoids bearing only five arms have been described from the Devonian under the genus *Catacocrinus*. A close examination of the forms from the Gilmore City formation shows that these two genera are not at all closely related. The genus *Gilmocrinus* has undoubtedly had its origin in the modification of one of the varieties of *Decadocrinus*. The anal structure of *Catacocrinus* is entirely unlike that of *Gilmocrinus*. The only other known occurrence of these forms is in the Madison limestone of Montana.

Occurrence. Gilmore City formation, Gilmore City, Iowa.

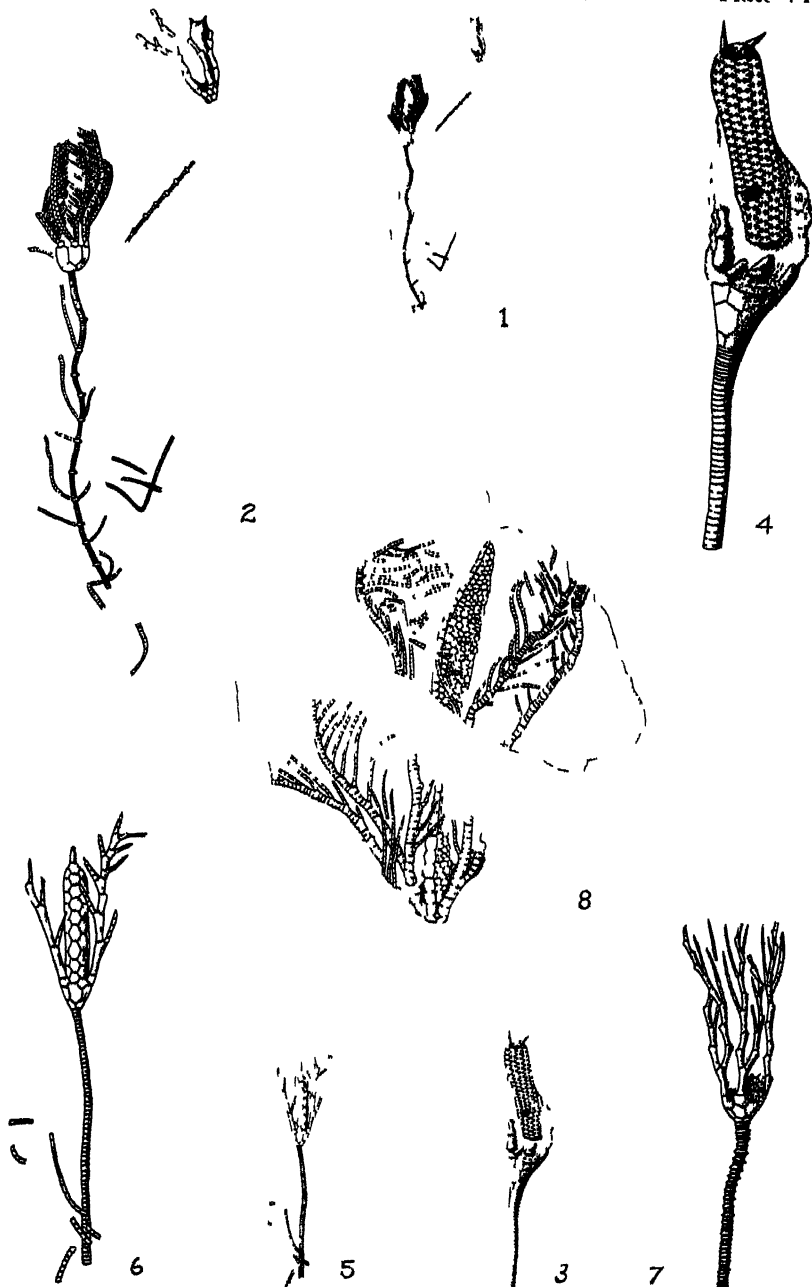
Types. State University of Iowa. Holotype No. 2089; paratypes Nos. 2087, 2088, 2090, 2091, and 2092.

EXPLANATION OF PLATE VII

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GILMORE CITY FORMATION

Plate VII



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HENRY FREDERICK WICKHAM, Editor

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Myxomycetes Found on the Bark of Living Trees

by

H. C. GILBERT and G. W. MARLIN

Some Noteworthy Fungi from Iowa

by

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Taxonomic Notes on the Tulasnellaceae

by

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Published by the University, Iowa City, Iowa

1933

MYXOMYCETES FOUND ON THE BARK OF LIVING TREES

II. C. GILBERT AND G. W. MARTIN

In April, 1932, a few pieces of bark bearing an abundant growth of *Protococcus* were chipped from the north side of a large cottonwood and placed in a moist chamber in the laboratory to permit the alga to develop. A few days later scattered sporangia of a small *Comatricha* were observed, which proved, upon examination, to be *Comatricha fimbriata*, previously known only from Great Britain. This unexpected appearance of a supposedly rare species suggested further examination of similar bark cultures, which has resulted in the finding of a number of unusual forms. It is probable that many of the species here reported are in reality common and widespread and may be found by the method described.

Since the first collection was from the north side of a tree, studies were at first confined to bark with such exposure, upon which mosses, liverworts, lichens and algae were growing. Experience shows that, on the whole, such locations are more favorable. Nevertheless, we have found numerous forms which inhabit bark on the south side of trees, exposed to the direct rays of the sun. Some species seem to prefer areas of the bark with little or no growth upon it. In a few instances, where collections were made simultaneously from the north and south sides of the same tree, at the same height from the ground, a larger number of species developed on the bark from the south side than on that from the north side.

In cutting the bark, care should be taken not to cut below the dead outer bark. If living bark is collected, it is sure to favor the growth of molds in the moist chamber, besides needlessly injuring the tree. It is well to remove the bark samples with the least possible injury or disturbance, wrapping each in a clean paper wrapper or bag properly labelled. Any sort of moist chamber is satisfactory. For small samples Petri dishes are excellent and permit examination with a minimum of disturbance. The bark is saturated, preferably with distilled water. Chlorinated tap water should be avoided. After the first day excess water should be removed. The

time required for fructification will vary with the species and presumably with the state of the plasmodium at the time of collection. Some species may appear the second or third day; most will require five or six days; a few may require two weeks or more.

Many of the species are very minute and inconspicuously colored and can be seen only with a good lens and a carefully adjusted light. Many fruit sparingly and the individual sporangia are widely scattered, hence the bark must be carefully scrutinized from all angles. Jarring of the culture or exposure to dry air during development may spoil some forms, hence sporangia should be allowed to mature thoroughly before removal for preservation. When mature, however, they should be removed promptly and cut away while the bark is moist, since many are so delicate that cutting the hard, dry bark will shatter the specimens.

It may be questioned whether fructifications produced under these circumstances are normal. In our experience, the variation from what may be regarded as typical of the species or variety concerned is less than is to be expected in the case of field collections. The fruiting structures are usually in better condition, there are fewer abnormal or imperfectly matured sporangia, and the average size is usually slightly larger. In addition, it is possible to observe many interesting developmental details.

A few species seem to be restricted to the bark habitat. *Diderma chondrioderma* seems to be typical of this group. *Echinostelium minutum* is usually found on bark, but occurs fairly commonly on other substrata. *Enerthenema papillatum* and *Cribraria violacea* usually occur on rotten wood; but the former appears occasionally and the latter rather commonly on bark. Many of the smaller species develop their plasmodia in the bark or in the thin layer of slime on its surface. There is often no indication of their presence until the sporangia begin to appear. It is evident that the bark affords limited opportunity for growth. Available food material is scanty and the water supply is definitely restricted except for short periods of moist weather. In response to these conditions most of the bark inhabiting species mature their sporangia quickly. Only on areas covered by mosses or lichens, where the water supply is more persistent, does a species such as *Didymium anomalum*, which is slow in development, appear.

No aethaloid species has been found. The habitat seems to be unsuitable for large plasmodia. A common type of fruiting is in

single, scattered sporangia, appearing a few at a time over a period of several days, suggesting that each sporangium may develop from a single small plasmodium.

The following list of species is not complete, but includes all those of which the identification seems to be reasonably certain. Several forms believed to represent undescribed species are reserved for later treatment.

Badhamia capsulifera Berk.

Forest Lake, Minn., on bark of larch. Fine colonies, but lacking lime in peridium, which is iridescent blue or bronze.

Badhamia orbiculata Rex

Iowa City, on moss on bark. A single collection.

Badhamia nitens Berk. var. *reticulata* G. List.

Iowa City, on bark of oak and ash; East Okoboji, Ia., on bark of linden; Lake Pepin, Minn., on box elder. The Minnesota collection on nearly bare bark; the others on bark encrusted with lichens and moss. This variety not previously reported from the United States.

Physarum crateriforme Petch

Wellman, Ia., on mossy bark. Not previously reported from the United States.

Physarum psittacinum Ditm., var. *fulvum* List.

Forest Lake, Minn., on bark of white birch. Scattered sporangia matured at intervals from small yellow plasmodia. The variety, not heretofore reported from North America, is perhaps too near the typical form to be worthy of recognition.

Didymium anomalum Sturgis

Homestead, Ia., on trees in river bottom; few and scattered sporangia among lichens and mosses. Lake Pepin, Minn., on bark of box elder with slight growth of mosses and lichens. Capillitium of slender, branched lime-filled threads; spores evenly warted, purple-brown, 9.5-10.5 μ .

Didymium clavus (Alb. and Schw.) Rabenh.

Iowa City, on bark of cottonwood.

Stemonitis nigrescens Rex

Iowa City, on bark of white oak, hickory.

Comatricha lara Rost.

Iowa City on bark of elm, ash, box elder. The sporangia on bark are in general more globose, somewhat paler, smaller and more scattered than those developing on rotten wood.

Comatricha fimbriata G. List. and Cran

Iowa City, on bark of elm and of willow. Fairly common, but not previously reported outside of Great Britain.

Comatricha nigra (Pers.) Schroet.

Iowa City, on white oak. A single scanty development. This exceedingly common species does not seem to be a normal inhabitant of bark.

Enertheuma papillatum (Pers.) Rost.

Iowa City, on bare bark of cottonwood; Waterloo, Ia., on elm; West Okoboji, Ia., on elm; Forest Lake, Minn., on elm. Usually somewhat more robust in culture than when developed outside.

Echinostelium minutum de Bary

Iowa City, McGregor, Luxemburg, Ia., Dorset, Vt., Mt. Storm, W. Va., on bark of various frondose and coniferous trees; common also on dead wood in culture. Many collections are distinctly pinkish or brownish, and there is considerable variation in size of sporangia.

Clastoderma debaryanum Blytt

Iowa City, not uncommon on bark of various species.

Clastoderma debaryanum Blytt var. *imperatoria* Emoto

Iowa City, on elm and linden bark. Four collections are referred to this variety, heretofore known only from Japan.

Cribraria minutissima Schw.

Iowa City, on elm bark. A single collection.

Cribraria violacea Rex

Iowa City, Hills, Bunch, Waverly, Estherville, West Okoboji, Ia.,

Vernon County, Wis., on elm, walnut, hawthorn, sycamore bark. Common.

Licea biforis Morgan

Iowa City, on elm; Hills, Ia., on sycamore; West Okoboji, Ia., on willow bark. Also on bark from dead branch of apple, Iowa City, in culture.

Licea tenera Jahn

North Liberty, Ia., on elm. Sporangia few and scattered on bark of a large tree covered with mosses and lichens. Previously reported from Oregon. This is the second report for North America.

Licea pusilla (Poir.) Schrad.

Iowa City, on bark of linden and ash. The only previous American report is that of Schweinitz. Our sporangia are very minute, mostly 0.2-0.3 mm. in diameter, the ridges of the peridium are sinuous and the spores are faintly warted, dark and rather small, mostly 12-13 μ . They may represent a distinct variety or even another species. Accompanying them are a few globose sporangia with short, thick stalks, apparently constituting a stalked variety.

Typical specimens are at hand developed in a moist chamber on rotten beech wood from Dorset, Vt., and similar sporangia with spores 12 μ in diameter on rotten birch wood from Deux Rivières, Ontario.

Hymenobolus parasitica Zukal

Iowa City, on elm, walnut, hackberry; West Okoboji, Ia., on bur oak; Bunch, Ia., on elm; Dorset, Vt. on hard maple; Mt. Storm, W. Va., on white oak.

The specific name refers to the fact that this species is supposed to be parasitic on lichens. It has appeared a number of times in our cultures, sometimes on lichens, sometimes on green algae, sometimes on bare bark. It has appeared once on the bark of a dead beech, collected at Dorset, Vt.

Kleistobolus pusillus Lippert

Iowa City, on bark of hickory; also on rotten cedar post covered with lichens and algae.

Orcadella operculata Wingate

Iowa City, on linden; Luxemburg, Ia., on white pine; Forest

Lake, Minn., on larch. In the Iowa City culture the fructifications are on mosses, on lichens and on bare bark, a few in one place, maturing slowly, and associated with *Echinostelium*, *Clastoderma* and *Arcyria pomiformis*. The sporangial contents were milk-white when young. This is of interest, as Minakata reports the plasmodium as dull orange.

Also on bark of dead beech, Dorset, Vt.

Margarita metallica (Berk. and Br.) List.

Iowa City, common on elm, ash and box elder; West Okoboji, Ia., on bur oak. The sporangia are often extremely minute, 0.2-0.4 mm. in diameter, with an extremely thin peridium, but the spores and capillitium are normal and the small specimens grade into larger ones.

Ophiotheca wrightii Berk. and Curt.

Iowa City, on elm and unknown bark; Vernon County, Wis., on cottonwood bark.

Perichaena corticalis (Batsch) Rost.

Waverly, Ia., on red cedar.

Arcyria pomiformis (Leers) Rost.

Iowa City, on mossy area on linden bark.

Arcyria cinerea (Bull.) Pers.

Iowa City and other localities. Not uncommon on bark of elm and cottonwood. Appearing singly or in small clusters.

Oligonema flavidum Peck

Wellman, Ia., on river birch, in clefts of bark where soil had lodged. Probably accidental.

Hemitrichia minor G. List.

Iowa City, on bark of elm and ash. Also on bark of dead apple and on refuse of various sorts. The typical form and the var. *pardina* have appeared on dung and litter from Iowa, and also from Ontario, but the variety has not been seen on bark. The capillitial spirals are exceedingly faint in our specimens, which suggest *Perichaena* or *Ophiotheca* rather than *Hemitrichia*. We are indebted to Miss G. Lister for the identification.

SOME NOTEWORTHY FUNGI FROM IOWA

DONALD P. ROGERS

I. *BOURDOTIA* and *HETEROCHAETELLA*

Bourdotia and *Heterochaetella* were originally described as subgeneric segregates from *Sebacina*, *Bourdotia* by Bresadola¹ for gloecystidiate and *Heterochaetella* by Bourdot² for cystidiate forms. The groups retain this subgeneric rank in the treatment of Rea,³ who introduced *Eusebacina* as a coördinate division to include the remaining species, marked by other types of hymenial structures or by none. Burt⁴ similarly regards the two groups as subgenera. Bresadola⁵, however, subsequent to the first publication of *Bourdotia*, made of it an autonomous genus; Bourdot⁶ likewise elevated *Heterochaetella* to full generic rank. The latter treatment is the one most generally adopted by continental European authors.

There is little justification, theoretical or pragmatic, for the idea that among the simpler hymenomycetes a new genus must be erected whenever a group of species is encountered having some distinctive hymenial development. Such a practice when carried out consistently and blindly amounts to an extension of the form genus principle. If taxonomic mycology represents only a means of indexing a certain considerable body of organisms, the practice may well be followed, and every group readily segregated in a key is to be given a name of its own. But ideally a taxonomic system represents an attempt to express relationship; and a consideration of other characters must lead to the conclusion that possession or lack of cystidia or gloecystidia is in itself by no means an infallible index of kinship. Therefore the status of each genus must be determined separately, and after consideration of all observable

¹ Annal. Mycol. 6: 46. 1908.

² Brit. Myc. Soc. Trans. 7: 53. 1921.

³ Brit. Basidiomycetac. 1922.

⁴ Mo. Bot. Gard. Ann. 13: 335-339. 1926.

⁵ Broteria, ser. bot. 11: 88. 1913.

⁶ Hymén. Franco 51. 1927.

characters. Whether or not the hymenial organs in question are invariably accompanied by other structures of sufficient weight to justify the erection of a new genus for the organisms possessing them, possession of cystidia or gloeocystidia is to be regarded as only one of a number of significant characters—a convenient means of keying out a portion of a larger number of organisms, and not the basis of a genus.

In the case at hand, the degree of relationship existing among *Bourdotia*, *Heterochaetella*, and the parent genus is best expressed, in the judgment of the present author, by retaining the segregates as subgenera only. There is little question that *Bourdotia* is a homogeneous group. Its species—as far as studied—have in common (1) blunt, yellow-resin-filled gloeocystidia, (2) basidia considerably elongate, and with short, subulate epibasidia, (3) a receptacle whose basal portion is composed of conglutinate, wholly indistinct, non-stainable mycelium traversed by the gloeocystidia and also by stout ascending hyphae which retain their individuality and which bear at their summits clusters of basidia, and (4) a texture firm in the fresh, arid-pruinose or arachnoid in the dried material. *Heterochaetella* is less homogeneous. *H. dubia* scarcely differs from a *Bourdotia* except in the form of the sterile hymenial organs. A *Heterochaetella* as yet undescribed which has been collected in Iowa, and apparently also *H. crystallina*, are wholly different, soft-gelatinous and pearly-pellucid in texture and appearance, with subdistinct hyphae and globose basidia bearing evenly cylindric epibasidia. *Bourdotia*, then, although a good genus according to the criterion of homogeneity, is not separable except by its gloeocystidia from the one *Heterochaetella*, and scarcely better from certain forms of *Eusebacina* which are thin and arid in texture. *Heterochaetella* has affinities with both arid and soft-gelatinous species of *Eusebacina*. If the old line between *Sebacina* and *Exidiopsis* cannot be maintained, much less can the groups included in *Bourdotia* and *Heterochaetella* be defended as natural generic segregates. They are, however, convenient systematic sections, and are here considered in that light, and retained as subgenera.

KEY TO THE IOWA SPECIES

- 1. Hymenium with bristle-like cystidia, thick-walled, with lumen dilated at the summit *S. (Heterochaetella) dubia*

1. Hymenium with clavate, blunt gloeocystidia, thin-walled, filled with yellow resinous material(*Bourdotia*) 2.
 2. Spores globose 3.
 2. Spores ovate or oblong 4.
3. Spores with prominent apiculus, (5-) 6-7.5 μ ; basidia ovoid*S. cinerella*
3. Spores with obscure apiculus, 4-5 (-6) μ ; basidia suburniform . *S. Eyreri*
 4. Spores broad-oblong, mostly under 6 μ ; fructification very thin, cinereous-pruinose when dry*S. deminuta*
 4. Spores oblong or ovate, over 7 μ ; fructification thicker, when dry forming an ochraceous-gray crust*S. cinerea*

Sebacina (Heterochaetella) dubia (Bourd. & Galz.) Bourd., Ass. Française Av. Sc. 45:576. 1922. *Heterochaete* Bourd. & Galz., Soc. Myc. Fr. Bull. 25: 30. 1909. *Heterochaetella* Bourd. & Galz., Hym. Fr. 51. 1927. Figs. 1 - 3.

Fructification mucous-waxy, grayish, drying to a vernicose-arachnoid, subochraceous layer or nearly evanescent; subiculum of indistinct, agglutinated hyphae; fertile hyphae scattered, 1.5 - 2 μ ; cystidia thick-walled, the lumen dilated apically, bristle-like to thread-like, straight to strongly flexuous, 60 - 430 μ long, 2 - 9 μ thick at point of greatest diameter; basidia ovoid, 7.5 - 9 (-14) \times 6 - 7.5 (-9) μ , with subulate epibasidia; spores oblong or oblong-ovoid, 4.5 - 6 (-9) \times 3.5 - 4.5 (-5) μ .

On decorticated wood of *Pinus strobus*; October; Pine Hollow, Dubuque County. Reported to occur throughout the year, and on both coniferous and frondose species.

S. dubia is composed of a notably variable group of organisms. There seems, however, to exist within this group no natural basis for division into more narrowly defined units. One of our specimens shows spores and cystidia exactly like those of material from Austria sent by Professor V. Litschauer as *H. dubia* var. *mesochaeta* form *brachyspora*—the cystidia moderately stout, mostly straight, 60 - 140 μ long. The other, collected the same afternoon and on the same substratum, agrees in spores and basidia; the cystidia, however, are so slender, flexuous, and elongate as to be taken at first for thick-walled hyphae; the maximum diameter is rarely more than 2.5 μ . The apical dilation of the lumen, however, and its basal occlusion by the incurving of the thick lateral walls, show that each thread is a complete organ, a cystidium, and not a fragment of a hypha. The basidia of this species, even more than those of the Bourdotias, appear to disintegrate, or to discharge their

spores and collapse, with the drying of the fructification; old material which has been moistened for examination shows only immature probasidia.

Sebacina (Bourdötia) cinerea Bres., Fung. trid. 2: 99. 1892.

Bourdötia Bourd. & Galz., Hym. Fr. 49. 1927. Figs. 4 - 6.

Fructification waxy, grayish hyaline, closely adnate, drying to a cinereous or ochraceous-gray crust; subiculum of indistinct agglutinated hyphae, traversed by irregular, nodulose fertile hyphae, 1.5 - 2 μ ; gloeocystidia subcylindric, blunt, often somewhat clavate or ventricose, slightly flexuous, the surface uneven at maturity, contents at first hyaline, soon yellow, resinoid, fragile, 15 - 35 (- 60) \times 4 - 6 (- 9) μ ; probasidia early obovate, finally ovate, cruciate-septate, 12 - 15 (- 20) \times 10 - 12 (- 15) μ ; epibasidia subulate-cylindric to cylindric, 8 - 15 - 25 \times 3 μ ; spores oblong or oblong-ellipsoid, somewhat flattened on one side, laterally apiculate, 7 - 11 (- 13) \times 4.5 - 6 (- 9) μ .

On decorticated wood of frondose species; April - June, August; Iowa City and Okoboji. A collection is at hand also from Deux Rivières, Ontario. Reported on both coniferous and frondose species, and throughout the year.

This species exhibits well a structural peculiarity of the subgenus. The basidia are borne in clusters of three or four at the summits of the ascending fertile hyphae. Commonly no two basidia in a group are of the same size; it seems likely that a single fertile thread continues to produce basidia for some time, new ones appearing at the apex as the older discharge their spores and collapse; the irregularities of the supporting hyphae are such as would be left by the dropping off of old branches or basidia.

Sebacina (Bourdötia) cinerella (Bourd. & Galz.) Killerm., Eng. &

Pr. Nat. Pflanzenfam. 2 ed. 6: 115. 1928. *Bourdötia* Bourd. &

Galz., Soc. Myc. Fr. Bull. 36:71. 1920. Figs. 10 - 12.

Fructification thin, waxy-pruinose, whitish, drying to an arid-pruinose film, sordid, pallid gray; hyphae mostly indistinct, the fertile 1 - 2 μ , tortuous, bristly with the stubs of old branches; gloeocystidia subcylindric, fusiform, or clavate, 15 - 30 (- 40) \times 4 - 7 (- 9) μ , the content at first hyaline, soon becoming yellow, resinoid, fractured; basidia in clusters of 2 - 4, ovoid, clearly or obscurely cruciate-septate, the epibasidia straight, subulate, 3 μ

thick at the base, up to $8\ \mu$ long; spores exactly globose, $6 - 7.5\ \mu$, with a conspicuous peg-like apiculus, $1.5 - 2\ \mu$ in length.

On wood of *Pinus strobus*; October; Pine Hollow. Reported on all sorts of decaying vegetation, and throughout the year.

Sebacina (Bourdolia) Eyrei Wakef., Brit. Myc. Soc. Tr. 5: 126.

1915. *Bourdolia* Bourd. & Galz., Hym. Fr. 50. 1927. Figs. 7-9. Fructification very thin, waxy-pruinose, hyaline, drying to an extremely delicate whitish arachnoid bloom, or evanescent; fertile hyphae erect, tortuous, $1.5 - 2\ \mu$; gloecystidia subcylindric, with granular yellow-brown content, $12 - 20 (- 35) \times 3.5 - 6 (- 7)\ \mu$; basidia in clusters, early pyriform, broadest near the base, later urniform, cruciate-septate, $9 - 11 (- 13) \times 6 - 8\ \mu$, with epibasidia at first divergent, later flexuous, slender, $5 - 9\ \mu$ long; spores globose, $4 - 6\ \mu$, with an inconspicuous apiculus.

On decorticated wood of *Quercus* and *Ulmus*; July, October; Iowa City, Okoboji. Reported to occur on *Fagus*, and from May to October.

The form of the spores affords a ready means of identification of this fungus, but its most striking and unique character is the basidial form. The urn-like proportions of the hypobasidium contrast sharply with the evenly ovoid shape of this body in the preceding and the heavy, oblong proportions in the following; the slender, tapering, flexuous epibasidia are in equally sharp contrast with the stouter structures of the other two species.

Sebacina (Bourdolia) diminuta Bourd., Ass. Fr. Av. Sc. 45: 575.

1922. *Bourdolia* Bourd. & Galz., Hym. Fr. 50. 1927. Figs. 13-16.

Fructification extremely thin, waxy, grayish, drying to form a grayish area on the substratum, scarcely perceptible even as a bloom; hyphae mostly indistinct, the fertile scarred with stubs of dead branches, $1 - 3\ \mu$; gloecystidia subcylindric, with hyaline, then yellow, resinous content, $12 - 20 (- 35) \times 3 - 4.5 (- 6)\ \mu$; basidia usually 2 or 3 in a cluster, ovate-oblong, cruciate-septate, $(7 -) 9 - 10.5 \times 5 - 7 (- 8)\ \mu$, the epibasidia subulate, $4 - 6\ \mu$ long; spores broadly oblong, abruptly attenuate at the base, laterally apiculate, $4 - 6 \times 3 - 4.5\ \mu$.

On *Quercus* and *Populus*; July, August; Okoboji. Reported from autumn to winter, and on pine.

II. OTHER HETEROBASIDIOMYCETES

Tremella aurantia Schw. ex Fr., Syst. myc. 2: 213. 1823. Schw. Naturf. Ges. Leipzig Schrift. 1: 114. 1822. *Naematelia* Burt, Mo. Bot. Gard. Ann. 8: 368. 1921. *N. quercina* Coker, El. Mitchell Sc. Soc. Jour. 35: 135. 1920. Figs. 17 – 19.

Fructification a hemispherical or more elongate, cocksecomb-shaped mass, deeply rugose and plicate, sometimes slightly lobed, the surface rough granulose, when fresh brilliant yellow-orange to orange, drying ochraceous to deep bay brown (ochre to about Van Dyke brown of Ridgway), near the base with a white fibrous core running up in streaks towards the summit; hyphae long-celled, thin-walled, nodose-septate, sparingly branched, hyaline, embedded in a hyaline gelatinous matrix, in the fibrous base lacking the matrix, collapsed, somewhat thicker, mingled with submoniloid, irregular, short-celled, tortuous strands not collapsing; basidia at first small, clavate-ellipsoid, when mature globose, cruciate-septate, 15 – 16 μ , with a clamp at the base, the cells not tapering at the summit, but giving rise abruptly to the four epibasidia, up to 100 μ or more long, 2 – 3 μ in diameter, inflated distally at or just below the surface to form a vesicle up to 7 μ thick, subglobose to slender-oval, tapering to the subulate sterigma; hypobasidia collapsed before discharge of spores; spores globose, indistinctly 1 – many guttulate, mostly 9 – 10.5 μ in diameter, slightly yellowish under the microscope.

On frondose wood.

This fungus was assigned to *Naematelia* by Coker and Burt on the basis of the white, fibrous core. The nongelatinous area is not distinctly delimited, as in *N. encephala*; it is scarcely homogeneous even at the base—may well even be as Coker has described it, a narrow white zone bordered both inside and out by gelatinous material; in our specimens it is as shown in the accompanying photograph, with irregular streaks extending half-way up from the base in the thicker portions of the fructification. On the whole, it appears preferable to follow Bourdot & Galzin, Bresadola, and Neuhoﬀ in discarding *Naematelia*, even for *N. encephala*, and distributing its species among *Tremella* and *Exidia*.

The figures represent part of a very beautiful collection taken by Dr. G. W. Martin on *Carya pecan* at Urania, Louisiana. The largest of the fruit-bodies shown is a good two inches high, exceeding considerably the upper limit of size given by Coker and Burt;

other fructifications, in less perfect condition, were more than four inches high. The fructification apparently persists for some time, and a section through one of the folds shows well the stages in basidial ontogeny. The young basidia are found nearest the middle of the fold, borne on moderately long lateral branches or almost sessile on the ascending hyphae which farther out are already supporting older basidia. The probasidium is at first a clavate terminal cell, so slender as to resemble some sort of conidiophorous apparatus. It elongates and swells, retaining its oval proportions for some time, but finally becoming a perfect globe. The basidia which have attained their full size and have not yet reached or only just passed the stage of septation lie somewhat nearer the surface than the younger cells, not greatly intermingled with either them or the discharging basidia. Beyond them lie hypobasidia bearing epibasidia in various stages of development, the four on a single basidium usually being all dissimilar; often one or more have discharged their spore and, along with the hypobasidial cell at their base, collapsed, while the remaining ones are turgid. Above this layer may occur the colorless distorted remains of older basidia, and beyond these a dense superficial layer made up of the inflated apices of the epibasidia, tightly packed together by mutual pressure. Beyond this layer project the slender sterigmata, some with young spores.

The appearance of some of the fructifications is quite adequately expressed by Burt's "cockscomb-shaped." Coker's illustration is good for color, but shows a basidiocarp much more lobate and thinner lobed than any of ours.⁷ The recently published illustration of Bresadola⁸ shows a carpophore plicate rather than lobed; otherwise, nothing. The appearance of some of the older material is almost exactly that of dried peaches; the newer is much brighter.

Recently three gatherings of *Tremella aurantia* were unearthed in the mycological herbarium of the University of Iowa, all filed under the name *T. mesenterica*. One, brought in from Canoe Creek, Winneshiek County, by Professor B. Shimek, contains material almost as fine as that from Louisiana. The others were collected by Dr. T. H. Macbride, one at Okoboji, and one at Iowa City. The species seems not to have been reported from as far west as either Iowa or Louisiana.

⁷ El. Mitchell Sci. Soc. 35: pl. 23, fig. 1.

⁸ Icon. Mycol. pl. 1191. 1932.

Tremella subanomala Coker, Fl. Mitchell Sc. Soc. Jour. 35: 148. 1920. An *T. indecorata* Sommerf., Fl. Lapp. Suppl. 306. 1826? Figs. 20 – 22.

Fructification pulvinate, convex, appearing as though formed of many closely compacted tubercles, but cleft only part way to the base, firm fleshy-gelatinous, inferior or lateral in position, invariably erumpent from the bark, the surface finely granulose; pallid raisin-color—light olivaceous brown or cinnamon-brown—and darker below; upon drying becoming horny, blackish-cinnamon or fuscous, often pruinose with spores; hyphae slightly thick-walled, sparingly branched, nodose-septate, with yellowish content, $1.5 - 3 - 4.5 \mu$, mixed near the base of the fructification with irregular, contorted, short-celled hyphae with darker content, up to 6μ ; basidia with yellowish content, globose or ovoid-globose, about 17μ in diameter, cruciate-septate, producing epibasidia at first tubular, about 2μ in diameter, finally up to 80μ or more long, the tip swollen where emergent from the gelatinous matrix, $4 - 6 \mu$ thick, the hypobasidial segments collapsing, often before the discharge of their spores, and the walls then brown; spores globose or transversely flattened, usually uniguttulate, with prominent blunt apiculus about $1.5 - 2 \mu$ long, white in mass, germinating by repetition or by yeast-like sprouting, $10 - 11 \mu$ broad, $8 - 10.5 \mu$ long (exclusive of apiculus).

On corticate twigs and small boughs of *Quercus macrocarpa*; June to August; Okoboji.

This strongly characteristic fungus is abundant throughout the summer in the Elm Crest woods, Miller's Bay, West Okoboji Lake, near the Iowa Lakeside Laboratory. It occurs on fallen branches which have not yet been much decayed, oftenest on parts that are not in contact with the ground. Only once has it been collected elsewhere in the region; a single gathering was made on a similar bough of *Acer saccharinum*, in the much more mesic forest along the Little Sioux River, a few miles to the west. In the Elm Crest woods it has never been found on any host other than bur oak, although elm, hawthorn, red cedar, and ash occur.

In terms of Ridgway's *Color Standards and Nomenclature*, the hue of the lighter portions is pinkish-buff or light pinkish-cinnamon; the darker portions of fresh collections run through orange-cinnamon to Mikado brown, or through the more olivaceous tawny-olive to Saccardo's umber and sepia. The compound appearance of the fructification is shown in the photograph, although the color

value is not. The slightly granulose surface is characteristic. The spores are notable not only for their flattened form, but also for the possession of a circular area of thickened spore wall about the base of the apiculus which like the apiculus does not take the stain (phloxine) used in the examination of preparations.

The naming of this fungus presents something of a problem. Neuhoﬀ has described it in two places,^{9 10} as *T. indecorata* Sommerf. In so far as anything definite can be made out from the earlier descriptions concerning the nature of that form, our fungus would appear to be *T. indecorata*. However, in a note concerning our specimens in which he states that they are cospecific with his, Dr. Neuhoﬀ remarks that he no longer regards the form as *T. indecorata*, but rather as *T. albida* Huds. Whatever *T. albida* Huds. may have been, the description of *T. albida* in Fries,¹¹ applicable as it explicitly is to *T. cerebrina alba* as illustrated by Bulliard, is not at all the same as our species, but a clear white fungus, foliose, like *T. frondosa*. And it must be the Friesian, not the pre-Friesian *Tremella* which carries the epithet *albida*, whatever it may have been applied to originally. *T. albida* then cannot be the name of the organism under discussion.

The chief obstacle in the way of applying Sommerfeld's name is the enormous difference between our *Tremella* and the illustration of *T. indecorata* published by Fries.¹² The shape is shown carelessly and perhaps need not be taken into consideration. The color, however, a uniform deep fuscous, would deny all possibility of identifying the Iowa fungus with Sommerfeld's. The fact that quite conceivably no other *Tremella* ever collected would look like the picture suggests the possibility of disregarding it utterly. However, since there is such uncertainty concerning the characters of *T. indecorata*, it appears best for the present to use the name of whose applicability to the fungus under discussion there can be no question, *T. subanomala*. The case is always subject to correction in accordance with whatever additional light may be brought to bear upon it.

Eocronartium muscicola (Fr.) Fitzp.

The fruiting bodies of this auriculariaceous parasite of mosses are white, thread-like structures, 3 - 10 mm. long, composed of a

⁹ Bot. Archif 8: 268. 1924.

¹⁰ Ztschr. f. Pilzk. 15: 74. 1931.

¹¹ Syst. myc. 2: 215. 1823.

¹² Icon. Hym. pl. 200, fig. 4. 1817.

core of parallel hyphae supporting an outer layer of slender, transversely septate, tubular basidia, lying along the surface of the receptacle. The fungus is most completely at home in rich, damp mesophytic forest of a sort not frequently encountered in Iowa. In late June of 1932 it was found scattered over a considerable area of a heavily wooded, northward facing hillside along a small stream south of Estherville, attacking the mats of *Climacium americanum* which occurred there abundantly. The fungus was not producing spores, but some of the moss was placed in moist chambers and in a few days the receptacles were covered with basidia and spores were being discharged. Early in July a fine lot of *Eocronartium* was collected growing on *Amblystegium trichopodium* in a wooded swamp at one end of Heron Lake, just over the Iowa line in Minnesota. And finally, late in October a gathering of even larger but old and sterile fruiting bodies was taken on *Climacium americanum* growing among the shrubs of yew in Dr. Conard's boreal moss community at Pine Hollow near Luxemburg, Dubuque County.¹³

The account of *Eocronartium* given in Fitzpatrick's papers, ^{14 15} makes any further description of the fungus at this place superfluous. His photograph ¹⁶ shows the habit of the fructifications clearly enough for field recognition.

The determination of the hosts just named has been checked by Dr. H. S. Conard. He reports collecting *Eocronartium* on *Leskea gracilescens*, by the canal near Elm Crest woods, south of the Iowa Lakeside Laboratory on West Okoboji.

Saccoblastia sebacea Bourd. & Galz., Soc. Myc. Fr. Bull. 25: 15. 1909. Figs. 23 - 26.

Fructification tough-waxy to mucous-gelatinous, pruinose then glabrous and shining, from a thin film to 1 mm. thick, hyaline to slate gray, drying to a vernicose film, colorless, dusky, or olive-fuscescent; hyphae frequently branched, occasionally anastomosing, crooked, attenuated at the septa, 3 - 4.5 - 6 μ ; probasidia lateral, saccate, oblong-ovoid, sometimes elongate oblong, often 1 - 3 times constricted, the longer usually the narrower, 16 - 33 x 7 - 10 μ , apparently rarely erect, elongating from the distal end; epibasidia

¹³ Bryol. 35: 28 - 30. 1932.

¹⁴ Phytopath. 8: 197 - 218. 1918.

¹⁵ Am. Jour. Bot. 5: 397 - 419. 1918.

¹⁶ Phytopath. 8: pl. 1, fig. 5.

slender just above the probasidium, $4.5\ \mu$, expanding abruptly to form the cylindric sporigenous portion, articulate-geniculate, the thickened distal portion about $50 \times 7.5\ \mu$, 3-septate, each cell producing a conic-subulate spore-bearing filament, $4.5 - 9\ \mu$ long, the entire basidium $75 - 100\ \mu$ in length; spores ovate-ellipsoid, flattened along one side, with a prominent blunt lateral apiculus, $11 - 14.5 \times 6 - 7.5\ \mu$, germinating by repetition.

On sodden sticks of driftwood—*Salix*, *Acer*, etc.; April, May, October; Iowa City.

The constriction of the longer probasidia and the geniculate form of the epibasidia are similar to those noted by Coker in his *S. caroliniana*.¹⁷ His figure 1 suggests what is the striking feature of the Iowa specimens, the fact that at the knee in the epibasidium the distal and basal portions are separated by a septum, which lies in the very slender connecting tube, about $1\ \mu$ in diameter, to which both portions narrow abruptly. A bend, but apparently of a simpler sort, is figured by Wakefield & Pearson for *S. sebacea*;¹⁸ apparently the constricted probasidia have not yet been noted in this species. However, variation is so great within a single lot of material of *Saccoblastia*, and so generally characteristic of gelatinous heterobasidiomycetes, that it seems inadvisable, in the absence of a large amount of material for comparison, to recognize it by any new taxonomic subdivision. If, as may be assumed, the Iowa fungus is to be allowed to remain in *S. sebacea*, then the thick slate-gray gatherings must represent the subspecies *subaridoisiaca*, even though the spores average a little under the size typical of that form; the tenuous hyaline growth, collected along with the thicker, must be assigned to the variety *vulgaris*. Dark-colored, but quite thin, fructifications, with the same microscopic characters as the thicker, suggest that here, as is so frequently the case among the heterobasidiomycetes, taxonomic complexities do little to bring about a satisfactory arrangement of the endless variations encountered.

III. AUTOBASIDIOMYCETES

Corticium roseopallens Burt

This conspicuous and beautiful *Corticium* appears to be a characteristic member of the fungus population of the river-bottom lands near Iowa City. When fresh it is recognizable at sight by

¹⁷ El. Mitchell Sc. Soc. Jour. 35: 121; pl. 53. 1920.

¹⁸ Brit. Myc. Soc. Trans. 8: 218; fig. 4. 1923.

its soft, waxy-gelatinous texture, recalling that of some of the heterobasidiomycetes, and its clear rosy-salmon or bright flesh color. When dry it forms a closely adnate layer, pale flesh-pink to orange-pink, equally characteristic. Microscopic characters are of course confirmatory, and are described accurately by Burt.¹⁹

In October of 1932 an unusually abundant collection of *C. roseopallens* was made at Hills, Johnson County, by Mr. H. C. Gilbert. The fungus was growing on the lower side of a prostrate willow log, partially protected by the ground and the loose bark. It covered the substratum in an almost unbroken sheet, six or eight feet long, averaging perhaps a foot wide. A number of smaller collections were made late in the autumn along the river north of Iowa City, and in March of 1933 the fungus was again found, in good condition, east of Hills. None of the logs attacked by *C. roseopallens* were above the level of the spring flood-waters.

Corticium tulasmelloideum v. Hohn. & Litsch., Akad. Wiss. Wien Sitzb., Math.-Naturw. Kl., Abt. 1, 117: 1118. 1908. *Hypochnus* Rea, Brit. Myc. Soc. Trans. 12:222. 1927. Fig. 27.

Fructification very thin, waxy-pruinose, grayish or bluish gray, closely adnate, drying to a pallid slate-gray, pruinose film; hyphae indistinct, nodose-septate, $2.5\ \mu$ (Bourdot & Galzin); basidia clavate, $9 - 11 (- 20) \times 4.5 - 6 (- 8)\ \mu$, with 4 subulate sterigmata about $4\ \mu$ long (up to $9\ \mu$, teste H. & L.); spores globose-obovate, abruptly laterally attenuate at the base, finely asperulate $3.5 - 4 \times 3 - 3.5\ \mu$.

October; on decorticated wood of *Quercus* and *Pinus strobus*; Iowa City, Pine Hollow. Reported on all sorts of vegetable debris.

The Iowa collections represent the fungus described by Bourdot & Galzin,²⁰ a little smaller than the type, but scarcely separable, and assigned by them to the species of von Hühnel & Litschauer. *C. tulasmelloideum* was transferred to *Hypochnus* apparently because of its asperulate spores; but they are not in the least typical *Hypochnus* spores, and the structure of the fructification is wholly that of a *Corticium*. The bluish-gray color of the receptacle seems to be a constant character.

Physalacria inflata (Schw.) Pk.

This curious basidiomycete, apparently unreported from Iowa,

¹⁹ Mo. Bot. Gard. Ann. 13: 240. 1926.

²⁰ Hym. Fr. 235. 1927.

was found growing on a half-rotted willow stump near Homestead, late in September of 1931. The fruiting body consists of an irregularly subpubescent, globose, hollow, thin-membranous head, 1 – 3 mm. or somewhat more in diameter, borne on a delicate, almost thread-like stalk up to 4 mm. long. The color was yellowish white at the time of collection. Sections of the fructification show that it is laterally stipitate and dorsiventral, with the hymenium on only one surface, as noted by Krieger.²¹ The genus, characterized chiefly by its bullate pileus, appears something of an anomaly among the *Clavariaceae* where it is usually placed, but scarcely less out of place in the *Agaricaceae*, among which it is included as a primitive form, the type of *Boagaricus* n. g., by Krieger.

IV. MUCEDINACEAE

A number of delicate lignicolous hyphomycetes are in gross aspect sufficiently similar to certain of the less conspicuous basidiomycetes to be collected regularly by one searching for the latter fungi. A pallid or rosy, scarcely visible bloom on the underside of a sodden stick of decayed wood may well turn out to be a *Tulasnella* or *Corticium*, or equally well, an imperfect. The appearance of the growth to the naked eye being at best scarcely more than an indication that a fungus is present, examination under the microscope may be necessary in order to assign the organism to its proper class. Several of the *Helicosporeae* are of this sort; of these *Helicoon sessile* Morg., *Helicomycetes roseus* Lk., and *Helicomycetes scandens* Morg. occur among recently collected Iowa material identified by Dr. D. H. Linder.

Diplorhino-trichum candidulum v. Höhn. Fig. 29.

Perhaps the most abundant about Iowa City of such pruinoid hyphomycetes is *Diplorhino-trichum candidulum*. Like the material of von Höhnel's original collection, ours comes from sodden deciduous wood—oak, soft maple, willow—and is found fruiting in May and June. In its most vigorous development it forms a uniform silvery or grayish-white layer on the wood, in this strikingly resembling *Tulasnella pruinosa*; more frequently the layer is interrupted, and barely whitish. The erect conidiophores are stout, blunt to truncate, subequal, about $35 \times 3 - 4 \mu$, 2 – 3 (– 4) celled, near the apex denticulate as in *Rhino-trichum*. The conidia are

²¹ Md. Ac. Sc. Bull. 3 (1): 7, 8. 1923.

fusoid-cylindric, 2-celled, the apex rounded, blunt, the base truncate, $15 - 20 \times 3 \mu$. The genus is separated from *Rhinotrichum* by its uniseptate spores, and so far seems to be monotypic.

Pedilospora parasitans v. Höhn. Fig. 28.

This is a much more delicate hyphomycete, similarly visible only as a grayish bloom, disappearing completely with drying. It was described by von Höhnelt as parasitic—with a question mark—on *Helotium citrinum*. Two of the Iowa collections are associated on their substrata of decorticated wood with other hyphomycetes, and the third consists of the highly characteristic *Pedilospora* conidia scattered through a growth of a delicate *Sebacina*; but loose resupinates such as this are often intermingled, and there is no evidence in our material of parasitism. The conidiophores are stout, tapering, spur-like, 2 – 3 celled, about $15 \times 2.5 \mu$, arising perpendicularly from the short-celled repent sterile hyphae. The young conidium is at first a minute ovoid vesicle borne acrogenously by a very slender, tubular prolongation of the conidiophore. By the time it has attained a breadth of 2μ it has become bilobate and heart-shaped. The mature conidia are five-celled and furcate, the two branches parallel, the whole ovoid in outline, $12 - 16 \times 5 - 7 \mu$. A double-conic basal cell is early separated from the two arms by septa; the single septum across the middle of each arm is sometimes lacking, even in freed conidia; it is thus of later, or less constant, formation. The bizarre conidial form seems to be *sui generis*; von Höhnelt assigns the genus to the *Mucedineae Stauroporae*.

The studies which form the basis of this paper and the following one were carried out in the mycological laboratory of the university. The writer wishes here to record his great indebtedness and his deep gratitude to Dr. G. W. Martin for help and encouragement in these studies.

PLATE I

All figures drawn with camera lucida at a magnification of 2490 x, and reduced in reproduction to 1000 x, unless otherwise noted.

Figs. 1- 3, *Sebacina (Heterochaetella) dubia*.

Fig. 1, cystidia of var. *mesochaeta* (figure at left, 425 x).

Fig. 2, spores.

Fig. 3, immature basidia.

Figs. 4- 6, *Sebacina (Bourdopia) cinerea*.

Fig. 4, gloeocystidia.

Fig. 5, basidia.

Fig. 6, spores.

Figs. 7- 9, *Sebacina (Bourdopia) Eyrei*.

Fig. 7, gloeocystidium.

Fig. 8, basidia.

Fig. 9, spore.

Figs. 10-12, *Sebacina (Bourdopia) cinerella*.

Fig. 10, spores.

Fig. 11, basidium.

Fig. 12, gloeocystidia.

Figs. 13-16, *Sebacina (Bourdopia) deminuta*.

Fig. 13, fertile hypha bearing three immature basidia and the collapsed walls of old basidia.

Fig. 14, spore.

Fig. 15, basidia.

Fig. 16, gloeocystidia.

Figs. 17-19, *Tremella aurantia*.

Fig. 17, three basidia of different ages.

Fig. 18, inflated apices of epibasidia.

Fig. 19, spores.

Figs. 20-22, *Tremella subanomala*.

Fig. 20, portion of hypha.

Fig. 21, basidium.

Fig. 22, spores.

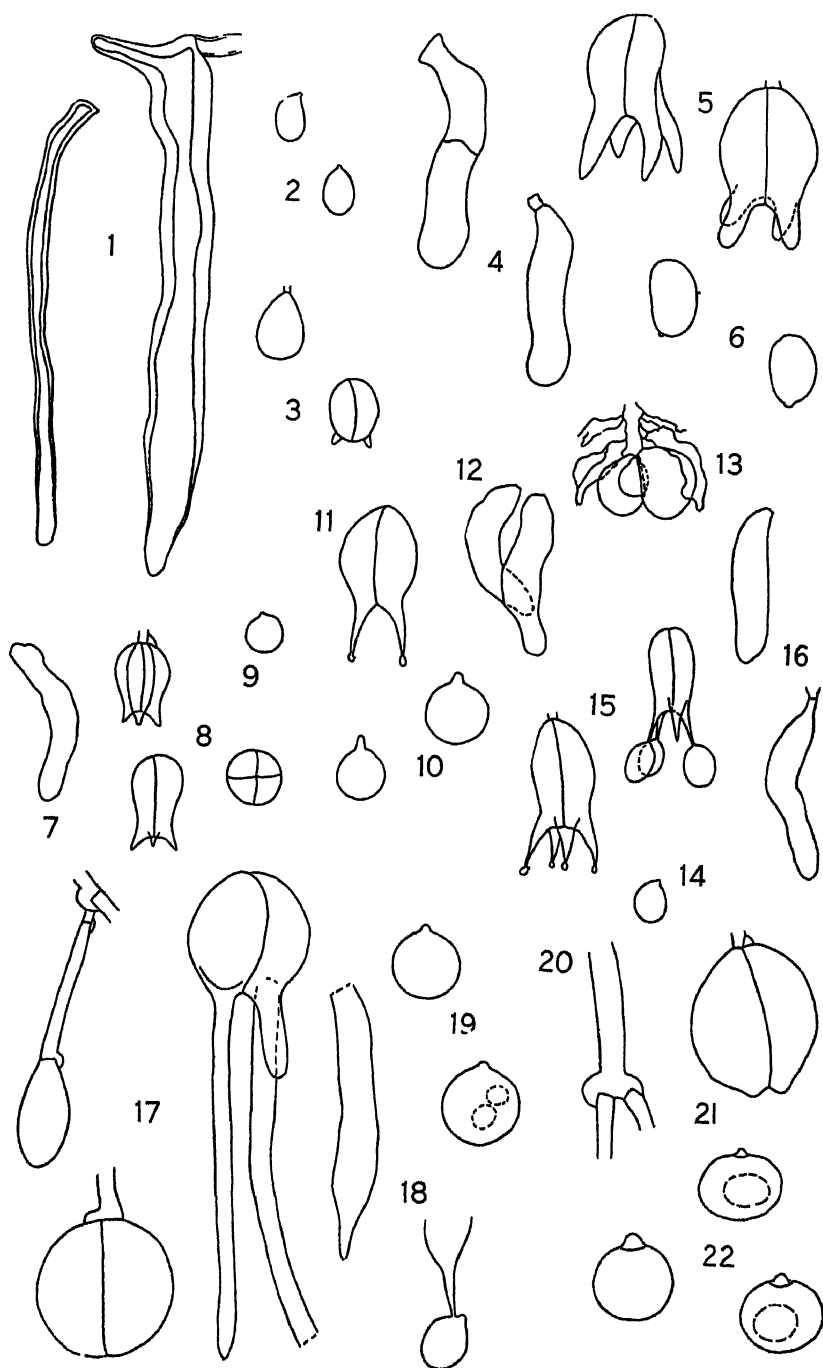


PLATE II

All figures drawn with camera lucida at a magnification of 2490 x, and reduced in reproduction to 1000 x.

Figs. 23 - 26, *Saccoblastia sebacea*.

Fig. 23, saccate probasidia of four different forms.

Fig. 24, basidium, showing articulation.

Fig. 25, summit of mature basidium, the basal segment already discharged.

Fig. 26, spores.

Fig. 27, *Corticium tulasnellodeum*, basidium and spore.

Fig. 28, *Pedilospora parasitans*, conidiophores and conidia.

Fig. 29, *Diplorhinostrichum candidulum*, conidiophore and conidium.

Fig. 30, *Tulasnella Cinchonae*, hymenial organs - probasidia.

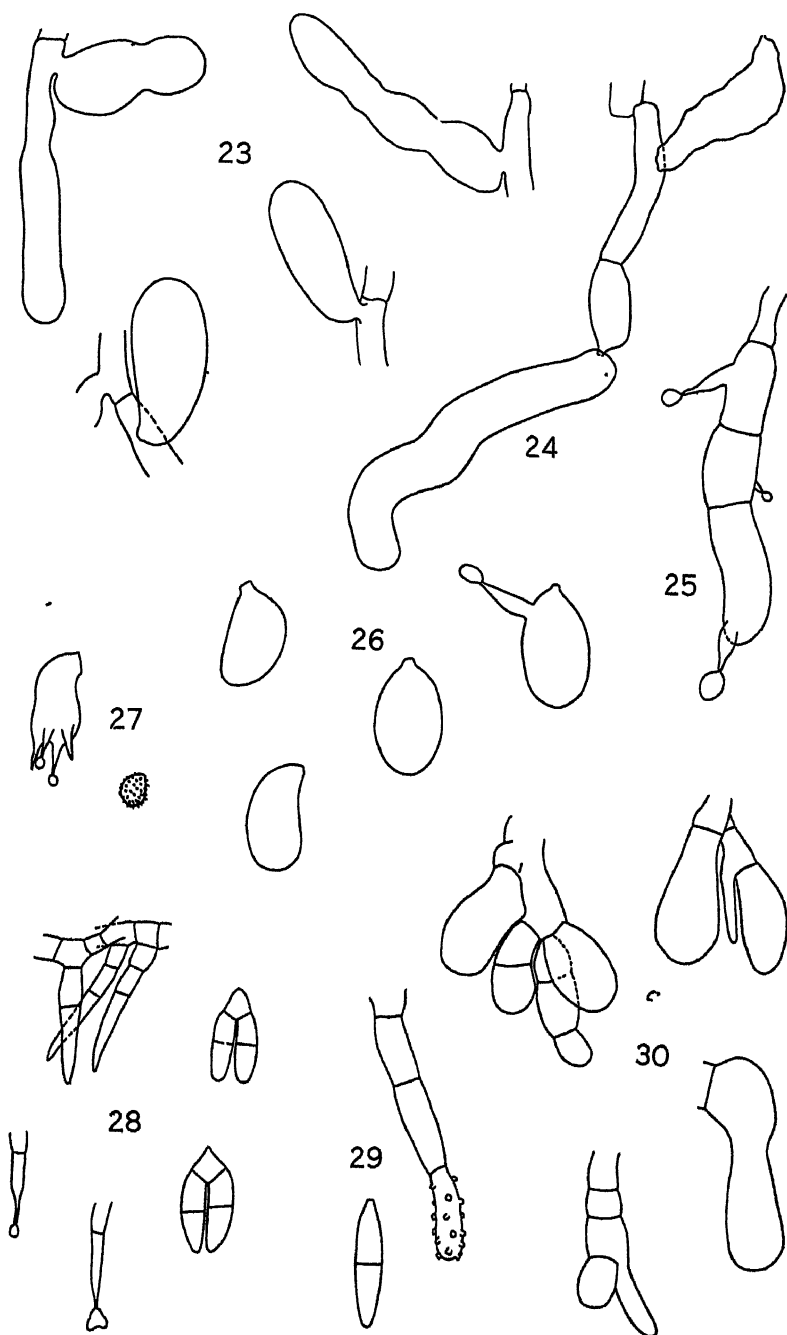


PLATE III

Fig. 31, *Tremella aurantia*.

Fig. 32, *Tremella subanomala*.



Figure 31



Figure 32

TAXONOMIC NOTES ON THE TULASNELLACEAE

DONALD P. ROGERS

Glocotulasnella pinicola (Bres.) Rogers

The description of the new species *Tulasnella griseo-rubella* Litschauer¹ appeared too late to be noticed in the author's recent review of the *Tulasnellaceae*.² The very careful and complete characterization and the illuminating discussion furnish such a wholly satisfactory picture of the fungus as is seldom encountered. Carpophore and basidia are of the *Glocotulasnella* type, well illustrated by the accompanying figures; Litschauer separates his species from *G. pinicola* by its thinner and paler fructification, hyphae with clamps, and often more—and less—elongate spores. However, its characters, although not included by Bresadola's original diagnosis of *Tulasnella pinicola*, fall well within the less narrow limits of *pinicola* as understood by the present author, hence *T. griseo-rubella* is to be reduced to synonymy under *G. pinicola*.

Tulasnella Cinchonae Rac. Fig. 30 of plate 2, supra.

This species was given a place among the *Tulasnellas* in the author's taxonomic treatment only after considerable hesitation and with the strongest of misgivings. A number of details, especially the character of the hyphae—thick, branching at right angles—and the habit—on living *Cinchona*, apparently parasitic—made it appear doubtful that the fungus was really a *Tulasnella*. The suggestion therefore was made that the affinities of Raciborski's fungus might well be with such forms as *Corticium vagum*; nevertheless, Raciborski's studied use of the terminology invented by Juel for the tulasnellaceous basidium made it impossible to see in any of the structures ascribed to *T. Cinchonae* anything except details of tulasnellaceous morphology.

Very recently two specimens of this species, from Raciborski's herbarium, now in the care of the Jagellonian University at Kra-

¹ Svensk Bot. Tidskr. 26: 448. 1933.

² Annal. Mycol. 31: 191-203. 1933.

ków, were made available for study, through the courtesy of Dr. S. Kulerynski of Lwów and Dr. B. Pawdowski of Kraków. In the better of the two specimens, for want of additional material perhaps to be considered typical, the fungus is parasitic on *Cinchona Ledgeriana*, and in the other on an unnamed *Cinchona*; both are from Soekanegara, Java. Microscopic examination makes it at once evident that the fungus is no *Tulasnella*. The hyphae are rather thick walled, some of the basal strands, 5 – 6 μ in diameter, having walls up to 1 μ thick. Although the whole fruiting layer does not surpass 70 μ in depth, it is definitely three-layered. The basal stratum is composed of close-packed, straight hyphae running parallel to the substratum. Above this lies a loose, open layer of ascending hyphae, arising at intervals from the basal strands, subdividing repeatedly as they approach the surface. The superficial stratum, continuous, at least over small areas, consists of the parallel, loosely arranged outer portions of the ascending hyphae and the oval or ellipsoid basidial cells. The latter are in tufts, closely packed together; with them are numerous cylindric bodies, 3 – 4 septate, the cells isodiametric, about 5 μ thick. The nature of these structures, and indeed, of the basidia, is not to be ascertained from any of the preparations made in the examination of the fungus. Some of the basidial cells bear upon their summit a cylindric prolongation strongly suggesting the epibasidium of *Septobasidium*. The grouping of the basidia and the possibility of the septate hymenial structures being conidial in nature add force to this suggestion. But no indubitable sterigmata or basidial septation have been observed; the basidia are so tightly packed together that it is difficult to be certain of their outlines; and the structures which appear to be septate basidia may conceivably represent a basidium and the cell beneath it. For the present, the reference of *Tulasnella Cinchonae* to *Septobasidium* cannot be considered anything more than a not completely unacceptable conjecture. Certain it is, however, that the fungus is not one of the Tulasnellaceae; like *T. anceps* and *T. grisea*, the other parasite forms assigned to the genus, it is an alien, placed in *Tulasnella* as the result of a morphological blunder.

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Sedimentation in Red River Below the Mouth of Washita River

by

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Sedimentation in Red River Below the Mouth of Washita River

INTRODUCTION

This paper is a report on one unit of a general study of Mississippi River and its major tributaries as agents of sedimentation. Other units have been reported previously.¹

GENERAL FEATURES OF THE REGION

The key map, Figure 1, shows the extent of the lower Red River region.

The lower Red River flows through the Gulf Coastal plain which lies between sea level and 600 feet above sea level. The relief is comparatively small and is due chiefly to the dissection by streams of a gently sloping plain. Two subdivisions of this plain are apparent: (1) hilly regions, and (2) flood-plain and terrace areas.

The hilly regions are composed of Cretaceous and Tertiary sediments. The hills stand from 100 to 200 feet above the river valleys. The stream drainage pattern in general is dendritic, but a series of low ridges or cuestas has resulted from the differential erosion of stratified, sedimentary rock formations. These ridges, except the northernmost, extend approximately northeast-southwest across the Red River valley and are known, from south to north, by the following names: Kisatchie Wold, Sulphur Wold, Saratoga Wold, and Lockesburg Wold.² They are formed by the outcropping edges

¹ Trowbridge, A. C.—Sedimentation at the Mouths of the Mississippi River—preliminary report (abstract): Geol. Soc. Am. Bull., vol. 34, p. 95, 1923; Disposal of Sediments Carried to the Gulf of Mexico by Southwest Pass, Mississippi River (abstract): Geol. Soc. Am. Bull., vol. 36, pp. 164-165, 1925; Building of Mississippi Delta. Amer. Assoc. Petroleum Geologists Bull., vol. 14, pp. 867-901, July, 1930.

Lugn, A. L.—Sedimentation in the Mississippi River Between Davenport, Iowa and Cairo, Illinois. Augustana Library Publications No. 11, Rock Island, Ill., 1927.

Littlefield, Max S.—Mississippi Gravels Below the Mouth of the Arkansas River (abst.): Geol. Soc. Am. Bull., vol. 38, p. 147, 1927.

Jones, Victor H.—Contribution of Sediments to the Mississippi Delta by Red River (abst.): Geol. Soc. Am. Bull., vol. 41, p. 165, 1930.

² Veatch, A. C.—Geology and Underground Water Resources of Northern Louisiana and Southern Arkansas. U. S. Geol. Survey. Prof. Paper No. 46, pp. 14-16, 1906.

the main channel of Red River almost completely from Shreveport to Natchitoches. Since the raft has been blasted away the lakes have been gradually disappearing as the rivers have resumed their normal courses. When boat traffic was important, Natchitoches owed its prominence to its location at the head of navigation on Red River. The river has since changed its course to a channel about 4 miles east of the town.

The average rainfall of the Three Rivers Region at the mouth of Red River is approximately 60 inches per year, and in the vicinity of Denison it is about 32 inches annually. Intermediate points have precipitation ranging between the two extremes.

In order to understand the sources for Red River sediments the rock formations which crop out along the river and near it must be considered. Detailed and quantitative information concerning the minerals in these formations is available only for a few exposures. Therefore as many outcrops as possible were studied and sampled in the course of the field work for this report. The rocks of the region range in age from Lower Cretaceous to Recent, and all are sedimentary. Table I is a generalized chart of the formations, and shows approximate average thicknesses.

From the Trinity sandstone, which is exposed near the confluence with Washita River, the Red River Valley traverses the younger formations of the Gulf Region until it joins the vast alluvial, Mississippi River plain near Marksville, Louisiana. The great bulk of the material in these formations was derived from pre-existing sedimentary rocks, and therefore may be regarded as reworked material. The Cretaceous and Tertiary formations of the region contain nearly all the common varieties of sedimentary rocks, and they give certain prominent characteristics to the Red River sediments. The red color, which is usually bright, is immediately noticeable. The coloring matter is obtained partly from the Permian and Pennsylvanian rocks farther west, but the volume of ferruginous sediment is greatly augmented in Louisiana by the addition of iron oxides from various Tertiary formations which contain considerable quantities of iron-bearing minerals such as glauconite, limonite, hematite, magnetite, and ilmenite. Ferruginous concretions are abundant in several strata of the Tertiary section. The high mica content of the Midway silts, sands, and clays is notable, and their color is typically lighter than that of the later Tertiary groups.

Table I
STRATIFIED FORMATIONS OF THE LOWER RED RIVER REGION
(Compiled)

<i>System</i>	<i>Series</i>	<i>Group—Formation</i>	<i>Lithologic Character</i>	<i>Approximate Thickness (feet)</i>
Quaternary	Recent	Port Hudson	Alluvium: gravels, sands, clays Gravels, sands, terrace deposits	
	Pleistocene	Citronelle	Fluvial sand, gravel, some clay	200
Tertiary	Miocene	Catahoula	Sand, ss., and clay	500
		Vicksburg group	Not at surface in NW Ia.	
		Jackson group	Sands, clays, some glauconite	500
		Claiborne group	Alternating sands and clays, some micaceous, glauconitic, lignitic, or ferruginous	1000
	Eocene	Wilcox group	Lignitic sands, clays; ferruginous ss. with limonite concretions	700
		Midway group	Mainly clays with some sand, glauconite, thin limestone beds, and mica	400

Cretaceous	Upper	Arkadelphia Nacatoch Marlbrook Anona Brownstown Bingen Eagle Ford Woodbine	Chiefly clays	600
Lower	Upper	Washita { Denison Fort Worth Preston Duck Creek Kiamitia	White and brown sand	135
			Marl, thin-bedded limestone, and clay	145
			Chalk and calcareous clay	460
			Marl	100
			Sand	300
			Sand	200
			Limestone and calcareous shale	175
			Limestone and shale	150
			Limestone	100
			Clay and shale	250
			Limestone	150
			Clay and marl	150
			Sand, sandstone	150
			Sand and shale	150
		Fredericksburg { Goodland Walnut		
		Trinity { Paluxy Glen Rose		

The conglomerates and gravels of the region are predominantly chert, quartz, and iron oxides. The texture of the elastic sediments is relatively fine. Except for concretions, chiefly calcareous and ferruginous, pieces of cobble size are rare. Information concerning the stratigraphy and structure of the lower Red River Region has been obtained especially from the sources cited below.⁴

The structure of the region is dominated by the Sabine uplift, a broad, low dome with a northwest-southeast axis. It occupies a large area in northeastern Texas and northwestern Louisiana and adjacent portions of Oklahoma and Arkansas. Although the quaquaversal dips have low angles, from a fraction of a degree to a maximum of 6 degrees, the dome is the dominant structure over an area of approximately 19,000 square miles. The river, which flows in a southeasterly direction across the center of the uplift, crosses the Tertiary formations on its north flank in southwestern Arkansas, and traverses the same formations in the reverse order on the south flank in central Louisiana. Southeast from Grande Ecore the dip decreases gradually toward the Gulf of Mexico.

METHODS

The river was sampled and studied during the field season of 1928 and during the last half of March, 1930. The entire channel below Shreveport was studied with the aid of a 16 foot boat equipped with an outboard motor, and samples were obtained by means of a sliding sleeve sampler designed by Lugn.⁵ Above Shreveport the river was studied at as many points as were accessible by automobile in the time available. Sample locations are indicated by number in Figure 1. Samples of sediments were taken

⁴ Matson, G. C., and Hopkins, O. B.—The De Soto-Red River Oil and Gas Field, Louisiana: U. S. Geol. Surv. Bull. 619, pp. 109-112, 1916.

Hammill, C. A.—The Cretaceous of Northwestern Louisiana: Bull. Amer. Asso. Petroleum Geologists, vol. 5, pp. 298-310, 1921.

Hones, C. W.—Atoka, Pushmataha, McCurtain, Bryan, and Choctaw Counties, Oklahoma: Oklahoma Geol. Surv. Bull. 40-B, 1927.

Matson, G. C.—The Caddo Oil and Gas Field of Louisiana and Texas: U. S. Geol. Surv. Bull. 620, pp. 1-35, 1916; The Pliocene Citronelle Formation of the Gulf Coastal Plain: U. S. Geol. Surv. Prof. Paper 98, pp. 167-192, 1916; The Catahoula Sandstone: Idem. pp. 209-226.

Moody, C. L.—The Tertiary History of the Region of the Sabine Uplift of Louisiana: Bull. Amer. Assoc. Petroleum Geologists, vol. 15, pp. 531-551, 1931.

⁵ Lugn, A. L.—Methods of Taking Sediment Samples from the Mississippi River. Iowa Univ. Studies, new ser., No. 104, Studies in Natural History, vol. 11, pp. 23-31, 1926.

from the channel, chutes or secondary channels, bars, banks, and outcrops of bedrock along the valley. The majority of the channel samples were taken in sections or series across the stream approximately at right angles to the channel. Depth of water and approximate current speed were noted at points where samples were obtained.

The samples were dried in the laboratory and separated into size grades by elutriation and sieving according to the millimeter scale of Wentworth.⁶ Subsequent study of the mineral grains was conducted by means of binocular and petrographic microscopes, and the data tabulated on appropriate cards. The scale of roundness used is that of Tester,⁷ which is indicated below:

R—Well-rounded
C—Curvilinear
r—Sub-round
a—Subangular
A—Angular

DESCRIPTION OF THE SAMPLES

Introduction

Most of the samples were obtained while traveling upstream during July, August, and early September of 1928. During that period the stage of water was almost continually falling after the unusual high stage of early July. As an illustration of this condition on the whole river the following gage readings from the St. Louis and Southwestern Railroad bridge at Garland City, Arkansas are typical.⁸

Day	July	August	September
6	14.2	11.4	5.8
12	9.7	9.5	5.8
20	10.8	7.0	5.1
25	9.0	6.8	4.9
30	11.0	6.1	4.8

In the descriptions of samples and features along the river the

⁶ Wentworth, C. K.—Methods of Mechanical Analysis. Univ. of Iowa Studies in Natural History, vol. 11, No. 11, 1926.

⁷ Tester, A. C.—The Measurement of the Shapes of Rock Particles. Jour. Sedimentary Petrology, vol. 1, pp. 3-11, 1931.

⁸ Frame, W. S.—Stream Gaging in Arkansas from 1851 to 1928. Arkansas Geol. Surv. Gaging Report 1, pp. 102-103, 1930.

banks are mentioned as *right* or *left*, the respective sides as one faces downstream. The terminology used in the descriptions and interpretations of the mechanical analyses is that of Udden⁹ and Wentworth.¹⁰ Although 265 samples were collected and studied, only a few of them can be described in this brief report. The *heavy minerals* are those having a specific gravity greater than 2.87, and were separated in bromoform.

*Samples from Red River Between the Junction with
Washita River and Texarkana*

Sources of river sediments at and near the junction with Washita River are the sandy Lower Cretaceous Washita formation, terrace deposits, and sands and silts of the present flood-plain. On March 28, 1930, a 15 foot thickness of the Washita limestone was being actively eroded on the left bank of Red River 1/4 mile above the mouth of the Washita. The water of the tributary was clear, and its current no swifter than 1 mile per hour. It could be distinguished sharply from the red water of the main stream as the two joined. Although the Washita drains hilly areas, its contribution to the load of the main stream is insignificant except during seasons of high water. The bottoms of both rivers are covered with alluvial sands and silts which are probably thin.

Analysis graphs of typical sediments from this locality are shown in Figure 2 (See also fig. 1). *Number 255* represents the coarsest material in the river, and it contains one subangular quartz pebble in the 4-2 mm. grade. It was taken from mid-channel where the depth was 3 feet 1/3 mile above the mouth of Washita River. Its heavy mineral content is as follows:

Biotite	11.0%	Corundum	10.0%
Hematite	20.0%	Zoisite	10.0%
Limonite	20.0%	Black opaques	29.0%

Sample 257 is typical of the finest sediment from the bottom of Red River at the same location, and is a sandy silt. Brown chert and iron oxides are responsible for its deeper red color. *Sample 261* represents the Washita River sediments 1/3 mile above the mouth, and is finer than the finest of the nearby Red River channel

⁹ Udden, J. A.—The Mechanical Composition of Clastic Sediments. Bull. Geol. Soc. America, vol. 25, pp. 655-744, 1914.

¹⁰ Op. cit., p. 24.

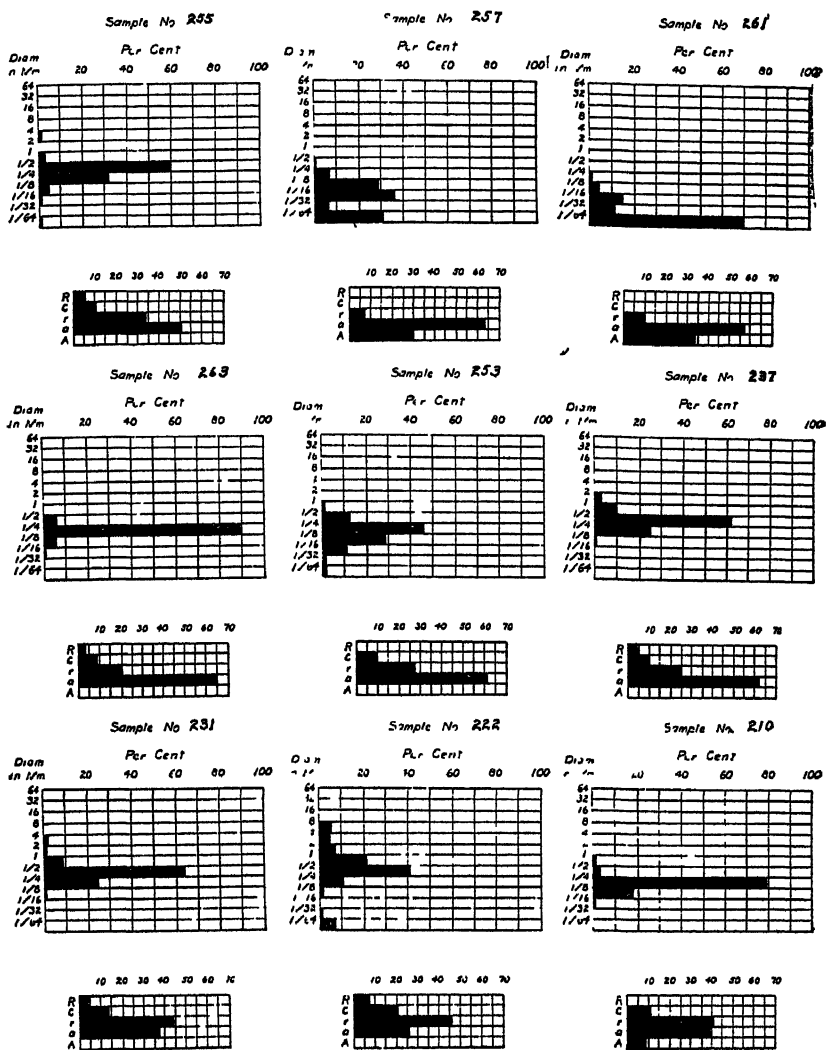


Figure 2. Analysis graphs of sediments from Red River between the mouth of Washita River and Texarkana.

LOCATIONS OF SAMPLES SHOWN IN FIGURE 2

- No. 263—1/8 mile below junction with Washita River; 20 feet from left bank, depth 2 feet, current 1 1/2 m. p. h.
- No. 261—From Washita River 1/8 mile above its mouth; 20 feet from left bank, depth 7 feet, current 1 1/2 m. p. h.
- No. 257—1/3 mile above junction with Washita River; 12 feet above water, left bank.

- No. 255—1/3 mile above junction with Washita River; mid-channel, just off small bar, depth 2 feet, current 3 m. p. h.
- No. 253—From high terrace outcrop in road cut on north bluff at the Red River Toll Bridge between Durant, Okla., and Denison, Texas; 35 feet below top of bluff.
- No. 237—50 yards below Red River Toll Bridge, from bar crest, 2 feet above water.
- No. 231—1 mile below Ambrose, Texas; 40 feet from right bank, depth 3 feet, current 3 1/2 m. p. h.
- No. 222—100 yards above railroad bridge at Arthur City, Texas; from main channel 15 feet from right bank, depth 3 1/2 feet, current 3 1/2 m. p. h.
- No. 210—50 yards above Highway 5 bridge across Red River 10 miles north of New Boston, Texas; from middle of chute on left of small bar, depth 3 feet, current 3 m. p. h.

material. The coarse silt grade of this sample contained 4% of heavy minerals in the following proportions:

Biotite	5.0%	Muscovite	10.0%
Hematite	35.0%	Tourmaline	10.0%
Hornblende	10.0%	Black opaques	30.0%

It shows a predominance of ferruginous minerals as do most of the heavy mineral separates of Red River sediments. *Sample 263* is a very well sorted channel sand from the main channel of Red River 1/8 mile below the junction. It represents the bulk of the bottom load which was being transported by traction and saltation in a smooth-flowing 3 1/2 mile current. The shape analysis diagrams of all the samples from the locality show a predominance of subangular grains.

At the toll bridge between Durant, Oklahoma and Denison, Texas the formations now contributing largely to the river sediments are exposed in a steep bluff approximately 100 feet high. From bottom to top they are respectively fossiliferous limestone and gray shale of the Washita formation, and a 35 foot thickness of deep red, unconsolidated terrace deposit containing many clay balls. *Sample 253* indicates the average mechanical composition of the terrace silts and sands. In the channel no sediments coarser than *Number 237* were found. It was taken in mid-stream from a bar crest 2 feet above the water, and represents the material transported by the swifter current of a water stage higher than that of September 8, 1928. Studies of shape and mineral content of channel sediments at the locality showed them to be very similar to the materials of the bluff outcrops. A few well rounded and

frosted grains were found in the coarser grades of all samples taken near the bridge. The proportion of heavy minerals in both bank and channel sediments is approximately 1 per cent.

From Ambrose to Arthur City, Texas the channel sediments exhibit remarkable uniformity, and are coarser on the average than those farther upstream. The valley is cut into the Woodbine sands which crop out at several places in the valley walls, and which, together with the red terrace sands, furnish most of the river sediments. The Woodbine in the locality is a light gray, orange, or yellow sand, which contains numerous iron oxide concretions, and is of coarser average texture than the Washita. During the dry season of early September, 1928 the river occupied only a small portion of its broad flood-plain. Its width was approximately 60 yards in many places, its maximum depth 6 feet, and the main current about 3 miles per hour.

Sample 231, shown in Figure 2, contains the coarsest material in the channel at a point 1 mile below Ambrose. It is a typical channel sand, and represents the main body of the bottom load. It contains 95 per cent quartz, some brown chert, and iron oxide. *Sample 222* was taken from the main channel 1/8 mile above the highway bridge at Arthur City. It contains the coarsest material found in the channel along the Texas-Oklahoma boundary, and the coarse grades are composed chiefly of ferruginous nodules, limestone fragments, and brown chert.

Between Idabel, Oklahoma and a point north of New Boston, Texas the river flows into the region of the Upper Cretaceous marls and chalks. Although the volume and current speed here are not greatly different from the volume and current farther upstream, the color of the water is different, and the sediments differ markedly. *Sample 210* contains the coarsest material of the channel at the highway bridge north of New Boston on September 6, 1928. Only 4 per cent of it exceeds 1/4 mm. in diameter. Suspended sediment caused the water to be gray-brown in color instead of the typical red of other localities. No sample from near this bridge contained more than .05 per cent of heavy minerals.

From the mouth of Washita River to the Texas-Arkansas boundary the influence of local sources of sediment is clearly evident. Coarseness of channel sediments, quantity of heavy minerals, and character of suspended sediment in the river reflect the character of nearby bluff and bank outcrops within a relatively short distance.

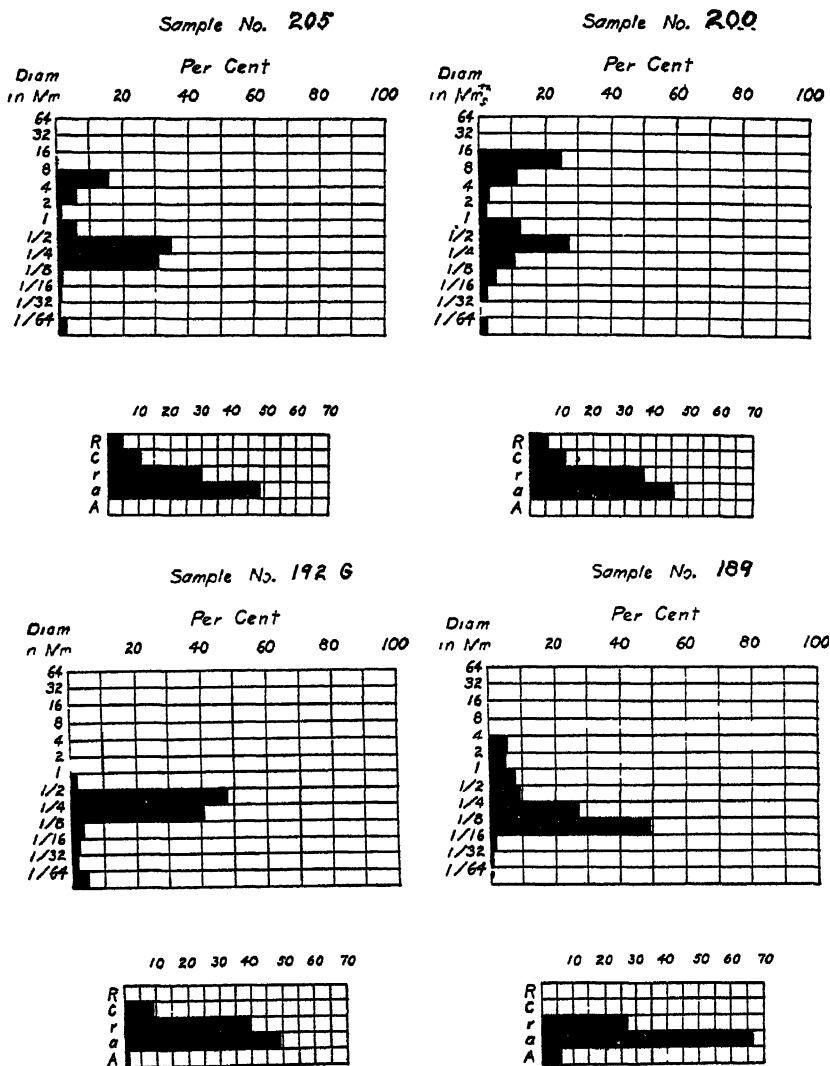


Figure 3. Analysis graphs of sediments from Red River between Index, Arkansas and Shreveport, Louisiana.

LOCATIONS OF SAMPLES SHOWN IN FIGURE 3

No. 205—1/2 mile below Index, Ark. (10 miles north of Texarkana); from top of submerged bar in midstream, depth 2 1/2 feet, current 3 m. p. h.

No. 200—50 yards below the ferry across Red River at Fulton, Arkansas; 50 feet from right bank, depth 2 1/2 feet, current 2 m. p. h.

- No. 192G—Upper Claiborne sand from a cut of the Kansas City and Southern Railroad; 1 mile northeast of Vivian, La.
No. 199—1/2 mile above Sentell Landing (13.4 miles north of Shreveport, La.); 70 feet from right bank, depth 2 feet, current 2 1/2 m. p. h.

*Sediments from Red River Between Index, Arkansas
and Shreveport, Louisiana. (Fig. 1)*

The Red River valley in southwestern Arkansas contains great quantities of Port Hudson terrace silts and gravels. It is about 10 miles wide on the average, and is crossed obliquely near Fulton by the Saratoga Wold, a low ridge caused by the outcropping edge of the Nacatoch sand and gravel. In harmony with the coarser sediments exposed along the banks the channel sediments are coarser than those anywhere upstream as far as the Washita. All but the coarsest material available was subject to transportation by the current which flowed at a speed of 4 miles per hour in many places. The presence of pebbles up to 8 mm. in diameter resulted in their accumulation in the main channel to form lag deposits in a few places. The mechanical analysis graphs of *Samples 200 and 205*, shown in Figure 3, represent the lag deposits, and show that pebbles are fairly common in the channel in some parts of this stretch. *Number 205* was taken from a shallow portion of the main channel in swift current 1/2 mile below Index, Arkansas (10 miles north of Texarkana). *Number 200* was obtained in the main channel at Fulton. The common type of well sorted channel sands from this stretch are composed chiefly of medium or coarse sand grains. They contain about 95 per cent quartz, and usually some grains of chert, muscovite, iron oxide, and nodular calcite.

In the northwestern corner of Louisiana the Red River Valley is cut into the Claiborne formation which consists chiefly of ferruginous sands and shales. Hematite and limonite concretions are abundant in it, and much of the argillaceous material becomes red or brown when weathered. *Sample 192 G*, from a friable zone in the Claiborne near Vivian, is similar in size grade distribution, shape of grain, and in heavy mineral content to many of the river sands.

A feature of the channel at Sentell Landing, Louisiana (13.5 miles north of Shreveport) on September 3, 1928 was a great number of well developed sand waves which covered a large portion of the flood plain and about one-half of the channel on a straight reach. They bear some resemblance to large current ripple marks,

but form at an angle of approximately 45 degrees to the current instead of normal to it. Some of them have unbroken crests extending for 50 feet or more, and they are formed in the swift current of the channel where the maximum sized particles are being transported. At Sentell Landing they had an average distance of three feet from crest to crest and a height of 2 1/2 to 3 1/2 inches. Their ripple index was from 10 to 14. Pebbles were being slowly rolled up the long slopes and then dropped abruptly into the intervening troughs where they accumulated in the lee of the wave crests. The waves were migrating with the current. *Sample 189*, shown in Figure 3, represents the material from the sand wave troughs.

*Sediments from Red River Between Shreveport and
Coushatta, Louisiana (Fig. 1)*

The samples from this stretch were taken while traveling upstream by boat August 22 to 26, 1928, during which time the stage of water was falling from 1 to 3 inches or more daily. The valley has an approximate width of 7 miles and in many places shows the effect of ponding by the old log rafts. So tortuous is the channel between the two cities that its length is nearly 80 miles although the air line distance is 43 miles. The average gradient of the stream bed on this stretch is less than 6 inches per mile.¹¹ For a large portion of the distance the stream is confined between artificial levees. The country rock for nearly the whole distance between Shreveport and Coushatta is the Wilcox which has a broad area of outcrop near the center of the Sabine uplift. Because of vegetation, alluvium, and the well developed Port Hudson terraces, however, the Wilcox crops out at only a few places along the river.

Analysis graphs of typical samples from the Shreveport-Coushatta stretch are shown in Figure 4. *Numbers 164 and 148* represent the coarsest sediments found in the channel of Red River, and were obtained in parts of the channel which were constricted and in which the current was unusually swift. Such places occur commonly during seasons of falling water stage when the current is confined to the lowest portions of the bed. Current speeds of 5 and 6 miles per hour were observed in a few places. The secondary maximum in the distant coarse grade indicates a similarity to a

¹¹ Calculated from data in Surface Water Supply of the United States, Part VII, U. S. Geol. Survey Water Supply Paper 667, 1928.

lag deposit, but these two samples are not true lag sediments because even the coarsest ingredients were being rolled and shoved by the current. They were formed not by selective action by the current, but as a result of the type of material available to it. They

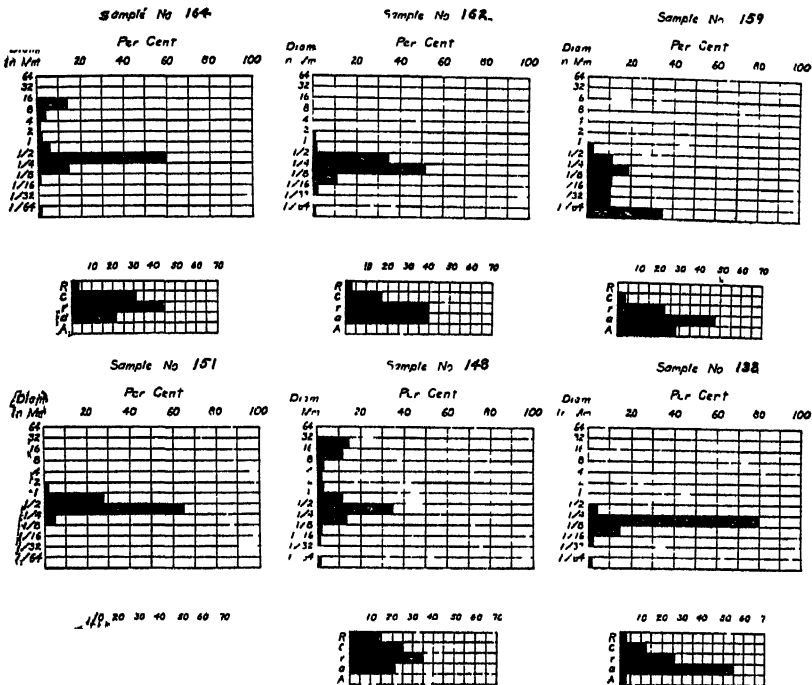


Figure 4. Analysis graphs of sediments from Red River between Shreveport and Coushatta, Louisiana.

LOCATIONS OF SAMPLES SHOWN IN FIGURE 4

- No. 164—20 miles below Shreveport; surface of bar 1 foot above water.
- No. 162—22 miles below Shreveport at a bend; 40 feet from right bank, depth 13 feet, current 3 m. p. h.
- No. 159—31 miles below Shreveport; middle of chute on right of bar, depth 4 feet, current 1 m. p. h.
- No. 151—40 1/2 miles below Shreveport; 30 feet from left bank, depth 2 feet, current 4 m. p. h.
- No. 148—48 miles below Shreveport; midstream off lower end of a bar, depth 3 feet, current 6 m. p. h.
- No. 138—4 miles above Coushatta; midstream, depth 5 feet, current 5 m. p. h.

resemble the pudding sand mentioned by Lugn¹² in Mississippi River and are rare in Red River. Many of the pebbles are composed of clay or lignite. The bulk of the sediment at the bend 20 miles below Shreveport, where *Number 161* was obtained, was medium and fine sand similar to that of *Sample 162*. The heavy minerals in the fine admixture of *Sample 162* amount to 80 per cent of the separate, and were identified in the following proportions:

Biotite	2.0%	Titanite	5.0%
Leucoxene	3.0%	Tourmaline	3.0%
Rutile	2.0%	Black opaques	85.0%

Sample 159 is a silt from a chute or secondary channel 60 feet wide and 2 feet deep at a point 30 miles below Shreveport. The current in it had been markedly retarded as the river stage fell, and the 1 mile per hour rate of August 25 was incompetent to transport any of the sand grades. Much of the silt load was being deposited. The prominent secondary maximum of the medium sand grade indicates that this grade was the abundant bottom load a few days before. *Number 159*, therefore is a silted channel sand or chute deposit resulting from decreasing current. This type of silty sand has been deposited over wide areas of the flood plain during falling water stages. Upon dessication it cracks into polygonal pieces up to a few inches in diameter, splits into thin layers, and warps with the concave side upward. Many of the pieces continue to curl until the edges meet and a roll is formed. When hundreds of these sediment curls are blown about by the wind they produce a dry, rattling sound similar to that of dried leaves.

Sample 151 is a typical, well sorted channel sand from a straight reach in the channel 40 miles below Shreveport. Its high proportion of well rounded and frosted grains indicates that wind action has been efficacious at some former time and that much of the material has been through more than one period of sedimentation. It consists almost entirely of quartz grains. Most of the channel sands from the locality are similar to it.

¹² Lugn, A. L.—Sedimentation in the Mississippi River Between Davenport, Iowa, and Cairo, Illinois: Augustana Library Publications No. 11, p. 97, Rock Island, Illinois, 1927.

Sediments from Red River Between Coushatta and Alexandria

From Coushatta to Grande Ecore the distance by river is nearly 40 miles, and the channel is near the left side of the valley for the entire distance. The valley width from bluff to bluff is about 7 miles, and the east bluff is bordered almost continuously by the terrace deposits. Although the Midway formation is the country rock, outcrops along the river are rare, and the Wilcox crops out in the bluff at Grande Ecore.

A relative uniformity in texture characterizes the channel sediments between Coushatta and Grande Ecore, and they show a marked contrast to the coarser, pebbly sands of the Shreveport-Coushatta stretch. The coarsest material found in the river between Coushatta and Grande Ecore was a sand containing 5 per cent of pebbles 4-2 mm. in diameter. The analysis graphs of this sample, *Number 115*, from the channel 3 1/2 miles above Grande Ecore, are shown in Figure 5. In it the following heavy minerals were identified:

Anatase	10.0%	Magnetite	25.0%
Hornblende	15.0%	Ilmenite	30.0%
Rutile	20.0%		

Number 121 is a typical, well sorted sand from the channel 10 miles above Grand Ecore. These sands contain 90 per cent quartz on the average, and the principal accessory minerals are chert, limonite, and black opaque minerals. They have a higher degree of angularity than the sands from any other portion of the river.

At Grande Ecore the river is flowing on a tough, black shale which forms the base of the Wilcox outcrop in the 175 foot bluff. *Sample 111*, represented in Figure 5, is a 6 foot, vertical section of a fine, friable, reddish sand from this outcrop. The peculiar form of the mechanical analysis graph is the result of sampling across thin beds of well sorted sand and silt. The sediments from this outcrop contain from 85 to 95 per cent quartz; and lignite, iron oxides, and muscovite are the most abundant accessory minerals. Smoothed and polished chert pebbles up to 64 mm. in diameter were found on the top of the bluff. They are probably remnants of an older high terrace deposit.

From Grande Ecore to Colfax, a distance of approximately 40 miles by water, the river flows close to the left side of its valley.

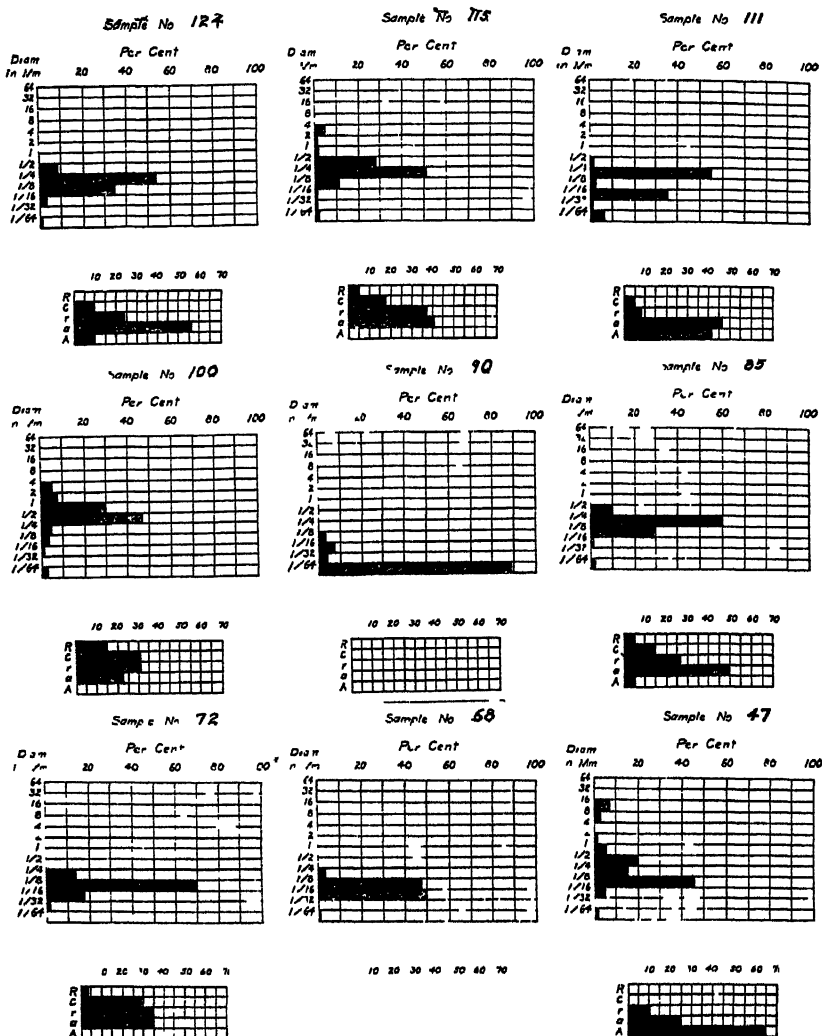


Figure 5. Analysis graphs of sediments from Red River between Coushatta and Alexandria, Louisiana.

LOCATIONS OF SAMPLES SHOWN IN FIGURE 5

- No. 124—10 miles above Grande Ecore at middle of a bend; 40 feet from left bank in main channel, depth 9 feet, current 4 m. p. h.
- No. 115—3 1/2 miles above Grande Ecore at a bend; 30 feet from left bank in main channel, depth 10 feet, current 3 m. p. h.
- No. 111—From the outcrop of The Wilcox formation in the bluff at Grande Ecore, 80 feet from top.

- No. 100—8 miles above Montgomery; midstream just above a bend, depth 6 feet, current 4 m. p. h.
No. 90—Opposite outcrop of Jackson strata in the bluff 5 miles below Montgomery; 60 feet from left bank, depth 8 feet, current 2 m. p. h.
No. 85—8 miles above Colfax; midstream at a bend, depth 9 feet, current 4 m. p. h.
No. 72—5 miles above Boyce; midstream, depth 6 feet, current 4 m. p. h.
No. 68—21 miles above Alexandria; midstream, depth 6 feet, current 4 m. p. h.
No. 47—2 miles above Alexandria; 50 feet from right bank, depth 8 feet, current 3 m. p. h.

The outcropping edges of the Claiborne and Jackson formations are actually visible in only a few places because of alluvium and slumped material. Their narrow bands of outcrop are due to the relatively steep dip on the Angelina-Caldwell monocline, a minor flexure on the south flank of the Sabine uplift.¹³ The terrace deposits occur at only a few places on this part of the river. The greater part of the main channel sediments in Red River, therefore, are derived from the deposits of the flood-plain and from outcrops of Upper Eocene formations along the left side of the valley. Very little material coarser than sand was found in any of these. The analysis graphs of *Samples 100, 90, and 85*, shown in Figure 5, indicate the fineness of the river sediments also. *Number 100* is the coarsest sample from this stretch of the river. It was obtained in mid-channel 8 miles above Montgomery where the stream flows over a resistant bed of dark blue shale, one of the spurs of bedrock now being eroded as a result of channel changes incident to the destruction of the great raft. The coarse grades of this sample are chiefly black carbonaceous shale fragments and clay pebbles.

An outcrop of fossiliferous Jackson 5 miles below Montgomery consists chiefly of fine sands, silts, and clays containing various amounts of iron oxides, partly in the form of concretions. This locality is one of several where clay pebbles were being formed in considerable quantity by the erosion of black shale at the foot of the bluff. The term "clay pebbles" is used here to mean fragments of clay or shale which have been worn into rounded shapes by the river current. They are common in the Red River sediments and originate in two ways. When the current erodes a bank de-

¹³ Moody, C. L.—Tertiary History of the Region of the Sabine Uplift of Louisiana. Amer. Assoc. Petroleum Geologists Bull., vol. 15, p. 549, 1931.

posit or older terrace containing previously formed clay pebbles, they are incorporated in the channel deposits. At the Jackson outcrop near Montgomery and at several other places the pebbles were observed in the process of formation where the river was eroding a shale outcrop. When chunks of shale fall into the stream some of them resist soaking and disruption for a few days or weeks. They may be perfectly rounded by abrasion, and may become studded with small quartz or chert pebbles.

Sample 90 was gouged from the firm clay bottom in the river channel near the outcrop. *Sample 85* represents the most common type of channel sand between Grande Ecure and Colfax.

Between Colfax and Alexandria the valley is cut into the relatively resistant Catahoula sandstone, and is markedly constricted. The Catahoula consists largely of fine sands and silts containing many frosted and pitted grains. Accessory minerals identified in samples from the formation are hematite, muscovite, chert, woody material, pyrite, zircon, and black opaque minerals. *Sample 72* is typical of the fine and very fine sands from this reach of the river. It contains 3 per cent of heavy minerals in the following proportions:

Biotite	5.0%	Hornblende	15.0%
Pyrite	5.0%	Zircon	15.0%
Hematite	30.0%	Black opaques	30.0%

Sample 47, from the main channel 2 miles above Alexandria, contains the coarsest material from this stretch. All the pebbles in it are brown chert, and the sand grades contain many pitted and frosted grains. Accessory minerals in the sand grades are glauconite, zircon, pyrite, and hematite. *Sample 68* is a concentrate of heavy minerals or placer type deposit from the channel just below Boyce. It contains 94 per cent of minerals having a specific gravity greater than 2.87, in the following proportions:

Hematite	10.0%	Magnetite	30.0%
Tourmaline	5.0%	Ilmenite	40.0%
Zircon	5.0%	Glauconite	6.0%
Rutile	4.0%		

The deep color of the river and its sediments is maintained and augmented on this stretch by contributions from the ferruginous terrace deposits and oxidized material from the Catahoula.

*Sediments from Red River Between Alexandria and the
Mouth of Black River*

The broad valley below Alexandria is bordered by low bluffs of Pleistocene sands, gravels, and silts for about 60 miles to a point opposite Marksville. From these east-facing bluffs the stream enters the great flood-plain of the Mississippi Valley. The samples from the lower river were obtained during July when the water was at a higher stage than in August and September when the upper river was sampled. Much greater turbulence and the presence of eddies on the insides of bends characterized this stretch. The silt content of the water was relatively large and the water was a deeper red color than it was a month later. At many places the rising water was cutting deeply into bank and bar deposits in and along the channel.

Sample 1 (fig. 6), which contains 4 per cent of 4-2 mm. pebbles, is the coarsest material found in the channel below Alexandria. It was obtained in mid-stream 1/2 mile below the city. The fine admixture contained 3 per cent of heavy minerals in the following proportions:

Anatase	5.0%	Zircon	5.0%
Topaz	5.0%	Magnetite	30.0%
Tourmaline	25.0%	Ilmenite	30.0%

Three miles below Alexandria the river was eroding the base of a 60 foot bluff. The largest pieces in the outcrop were pebbles about 64 mm. in diameter. A sample collected to show maximum sized material contained 80 per cent chert, 15 per cent limestone, 4 per cent dark, dense, igneous rock, and 1 per cent iron oxide. The bluff is probably the remnant of a Port Hudson terrace. *Sample 8*, Figure 6, is a very fine sand from the channel on the inside of a bend 6 miles below Alexandria. *Number 15* is a silty sand from a 9 foot depth of channel 16 miles below Alexandria. Fine and very fine sand was the most abundant material in the channel between Alexandria and Egg Bend. At that time the river was carrying a capacity load of silt and even a slight retardation of the current caused deposition of much red silt and clay.

Below Egg Bend the river follows a very winding course generally north and east between the Point Maigre and the Avoyelles

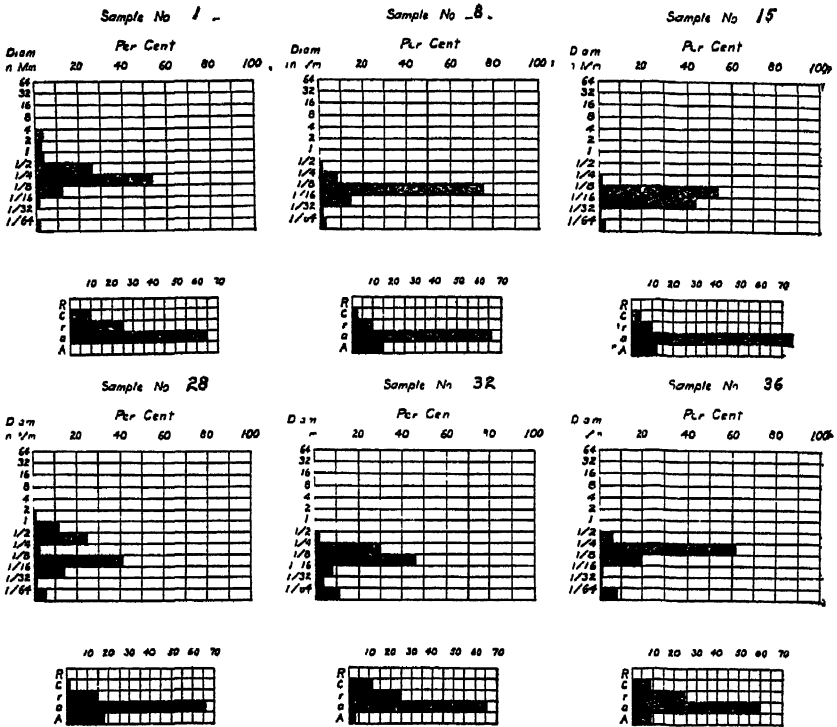


Figure 6. Analysis graphs of sediments from Red River between Alexandria and the mouth of Black River.

LOCATIONS OF SAMPLES SHOWN IN FIGURE 6

- No. 1—1/4 mile below Alexandria; midstream, depth 14 feet, current 4 m. p. h.
- No. 8—6 miles below Alexandria; 50 feet off lower end of a bar at a bend, depth 4 feet, current 2 m. p. h.
- No. 15—16 miles below Alexandria; from main channel 30 feet from right bank, depth 9 feet, current 1 1/2 m. p. h.
- No. 28—33 miles below Egg Bend; 50 feet from right bank, depth 12 feet, current 1 1/2 m. p. h.
- No. 32—From midstream in Black River 1 1/2 miles above its mouth; depth 30 feet, current 2 m. p. h.
- No. 36—From midstream in Red River 2 1/2 miles below the junction with Black River, depth 30 feet, current 6 m. p. h.

Hills. According to Veatch¹⁴ it was diverted from its old course to the southeast, the present course of Bayou Boeuf, by the log rafts which ponded the waters below Alexandria. The ponded waters found an outlet along the north side of the valley, and that course has been maintained since the destruction of the raft. For the lower 40 miles of its course the river flows generally northeastward on the swampy Mississippi River plain. Black River, largest tributary of the Red, joins it 24 miles above the mouth.

At the time the samples were taken from this part of the lower river, the water level was high enough to submerge the low banks at many places, and only 4 bars were seen above water below Egg Bend. The current was strong all across the stream in most places, and the water was very turbulent. Eddies were common, especially on the insides of bends. The heavy load of red silt colored the water so strongly that no light could be seen at a depth of 1 foot beneath the surface.

Sample 28 contains the coarsest material found in the river below the Avoyelles Hills, and the only one containing particles larger than 1/2 mm. in diameter. It was taken from the channel 33 miles below Egg Bend where the bottom was composed of firmly packed, ripple-marked sand. This material is represented by the lower half of the mechanical analysis graph. The coarser grains, 1/8 to 2 mm. in diameter, were being carried and shoved along on the hard-packed surface. *Number 32* is typical of the sediment in Black River channel near its mouth. In texture it resembles the fine channel sands of the main stream, but its color is gray instead of red or brown. The distant coarse grade is 90 per cent calcite, and wood fragments are numerous in all grades. Black River was contributing relatively small quantities of fine sand and silt, and its clear water presented a striking contrast to the brightly colored main stream. In heavy mineral content the Black River sediments near the mouth, except for a deficiency of iron oxides, are similar to those of Red River.

Sample 36, (fig. 6) from the main channel of Red River 2 1/2 miles below the confluence, contains 90 per cent frosted quartz grains in the major grade. The abundance of gray and black chert suggests the influence of the Black River sediments. The heavy

¹⁴ Veatch, A. C.—Geology and Underground Water Resources of Northern Louisiana and Southern Arkansas: U. S. Geol. Survey, Prof. Paper 46, p. 63, 1906.

mineral content of the sands from below Eag Bend is higher on the average than those from other parts of the river. The average proportion is 2 per cent of the fine admixture.

*Channel Sediments Taken at and Near the Confluence of Red,
Old, and Atchafalaya Rivers*

An unusual set of conditions exists at the mouth of Red River. Any one who has visited the region or has studied it is familiar with the fact that Red River does not flow into the Mississippi, but into the Atchafalaya when conditions are normal. At this point Red River water flowing south unites with the water of Old River, a west-flowing tributary of the Mississippi, to form Atchafalaya River which flows generally south to Atchafalaya Bay on the Gulf of Mexico. Thus all the Red River sediments are usually poured with its water into the Atchafalaya. When the Mississippi is at a very low stage and Red River is unusually high, the flow of water in Old River may be reversed; and Red River water and sediments are added to the Mississippi.

Several series of samples were taken across the channels of the three streams at various distances from their confluence. *Samples 245 and 181*, Figure 7, are typical sediments from Old River. *Number 245* contains the coarsest material that could be found in any of the channels. The two coarsest grades contain 75 per cent limestone fragments, some ferruginous nodules, and wood fragments. *Sample 181* is the normal type of channel sand from Old River 100 yards above the confluence. *Samples 171 and 213* are the coarsest and finest sediments from Red River channel 1/2 mile above its mouth. Sand grains up to 1/2 mm. in diameter are the largest grains that could be found in Red River near its mouth. Silts having a texture similar to that of *Number 169*, from the Atchafalaya 1/2 mile below the junction, are of common occurrence along the banks and in slower current deposits of the three streams. *Sample 170* was taken from the main channel of Atchafalaya River 1/2 mile below the junction.

The color of the sand grades in Red and Old Rivers is similar after elutriation and sieving. The finer particles of Red River sediments are red or red-brown, and those of Old River are gray. Therefore the color of sediments in the two streams depends largely on the coloring matter contained in the silts and clays which are in suspension and are mixed with the coarser silts and sands. Dur-

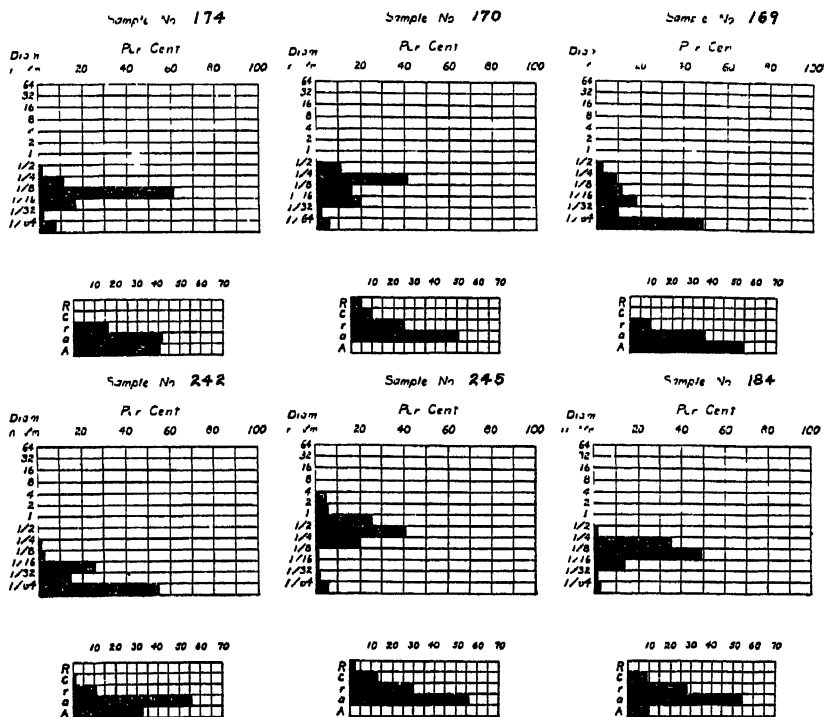


Figure 7. Analysis graphs of sediments obtained at and near the mouth of Red River.

LOCATIONS OF SAMPLES SHOWN IN FIGURE 7

- No. 174—1/2 mile above the mouth in Red River; 75 feet from left bank, depth 4 feet, current 2 m. p. h.
- No. 170—From Atchafalaya River 1/2 mile below junction with Red and Old Rivers; midstream, depth 14 feet, current 2 1/2 m. p. h.
- No. 169—From Atchafalaya River 1/2 mile below junction with Red and Old Rivers; 40 feet from right bank, depth 14 feet, current 2 m. p. h.
- No. 242—From Red River 1 mile above the mouth; 60 feet from right bank, depth 12 feet, current 1 1/2 m. p. h.
- No. 245—From Old River 3/4 mile above the mouth; midstream, depth 30 feet, current 4 m. p. h.
- No. 184—From Old River 100 yards above the confluence with Red and Atchafalaya Rivers; 60 feet from left bank, depth 18 feet, current 3 1/2 m. p. h.

ing normal and low stages of water no pebbles are contributed by Red River to the Atchafalaya, and Old River brings nothing larger than 4 mm. in diameter from the Mississippi. If the Mississippi rises to a high stage as it did in July, 1928, the water in Red River is backed up for many miles above its mouth. The current is considerably reduced under such conditions, and contributes nothing coarser than medium sand while these conditions prevail. No conspicuous differences were discovered between the heavy mineral content of Old River and that of Red River near its mouth.

SUMMARY

Relation to Mississippi Delta Sediments

The relation of Red River to the sediments of the Mississippi has been briefly explained. Most of the material from Red River mingles with the sediments carried by Old River and becomes a part of the Atchafalaya deposits. The Atchafalaya is the highest important tributary of the Mississippi system, and it forms an important outlet for the water of that system. Under present conditions relatively little sediment ever is carried into the Mississippi channel proper from Red River. The material contributed to the Atchafalaya system by Red River consists of dissolved salts, enormous quantities of red silts and clays, and sand grains up to a possible maximum of 1 mm. in diameter.

Sediment Types

Most of the sediments of Red River may be classified under 5 heads: *channel sands, chute deposits, muds, pudding sands, and lag materials*. The channel sands are far more abundant than all other types combined, and might be cited as the typical sediment of Red River. They are well sorted and contain relatively small amounts of silt. In many of them 80 to 90 per cent of the sample is contained in two size grades. *Samples 255, 263, 210, and 237* of Figure 2 are typical channel sands. They contain a few pebbles in some parts of the river, but no true gravels were found anywhere in the channel. The channel sands, therefore, represent the bulk of the coarse load of the river, and cover its bottom at most places in the main channel. The heavy mineral concentrates which occur in a few places might be included as a separate type, but their texture is that of sand. *Sample 68, Figure 5*, is an example.

The chute deposits are the silts or muds deposited by decreasing currents in the secondary channels. *Sample 159*, Figure 5, is a typical example, and has a high range of coarse grades.

The pudding sands are a rare type in Red River, and occur in the bank deposits or in the swiftest current of the main channel. The pebbles are predominantly clay, quartz, or chert. They represent a type of lag deposit in which the coarse pieces, pebbles up to 30 mm. in diameter, are incorporated in a coarse sand. The pebbles may be rolled or pushed along the bottom, but travel more slowly than the sands.

The muds are the finer materials deposited in slow current on the insides of bends, and wherever the current is much slower than that of the main channel. *Samples 90*, Figure 4, and *242*, Figure 7, are typical river muds. The maximum ingredient is the fine silt grade or the clay grade. The finer sediments are invariably deeper red in color because the iron oxides are concentrated chiefly in them. Thus they impart a bright color to the water, the bank sediments, and most of the sands.

Lag sediments are a rare type in the river chiefly because the materials available are usually small enough to be transported by the current in the main channel. In a few places where pebbles are available a scouring action has removed adjacent finer grades to leave sediments showing a secondary maximum of pebble-size grains. This type is exemplified by *Samples 200 and 205*, Figure 3.

Sources of Sediments

The sediments in the river are influenced by very local sources, and the bulk of the coarse material travels a relatively short distance. This relationship was recognized at many places along the river, and only a small part of the evidence can be presented here. A few examples must suffice. The sediments in the region of the Catahoula sandstone bear a resemblance to that formation in the following characteristics: (1) abundant zircon, (2) unusually large percentage of well rounded and frosted quartz grains, (3) many pebbles derived from calcareous rosettes and nodules, (4) comparative uniformity of many fine channel sands, (5) the presence of pyrite.

The channel sediments in the region of the Wilcox formation show the following similarities to the country rock: (1) abundant

lignite and woody material, (2) many pebbles and fragments of iron oxide, (3) great quantities of red silt.

In the region of the upper Cretaceous marls and chalks the river sediments are considerably finer on the average, and the color of the suspended silts and clays in that region modifies the typical red color of the water to brown or gray. The absence of pebbles in the lower 40 miles of the channel is proof that the coarse material occurs only near its sources.

Remnants of Organisms

Although the river contains many fish, shrimps, and clams, the shells and bones were rarely found in the channel sediments. The abundant gar-pike, which is a voracious scavenger, may be partly accountable for the destruction of other fish and shrimps. Abrasion by sand and pebbles under the influence of swift currents is also responsible for the disintegration of shells and bones before they can be preserved. The abundant vegetation of the region furnishes logs, stumps, and smaller fragments of wood to the river in many places.

Deposition and Erosion

Although the river has long been properly considered an old stream, it is actively eroding its channel in several places in Louisiana. A number of the obstructions now being cut away have resulted from channel changes occasioned by the great log rafts. The rapids at Alexandria and 8 miles above are typical of this situation. Erosion of tough clay strata is taking place at Coushatta and near Montgomery, Louisiana. In general Red River is a stream at or near grade, and is widening its flood plain by lateral planation, but exceptions such as those mentioned above are notable.

UNIVERSITY OF IOWA
STUDIES

University of Iowa Studies in Natural History

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Number 5

A Revised List of the Birds of Iowa

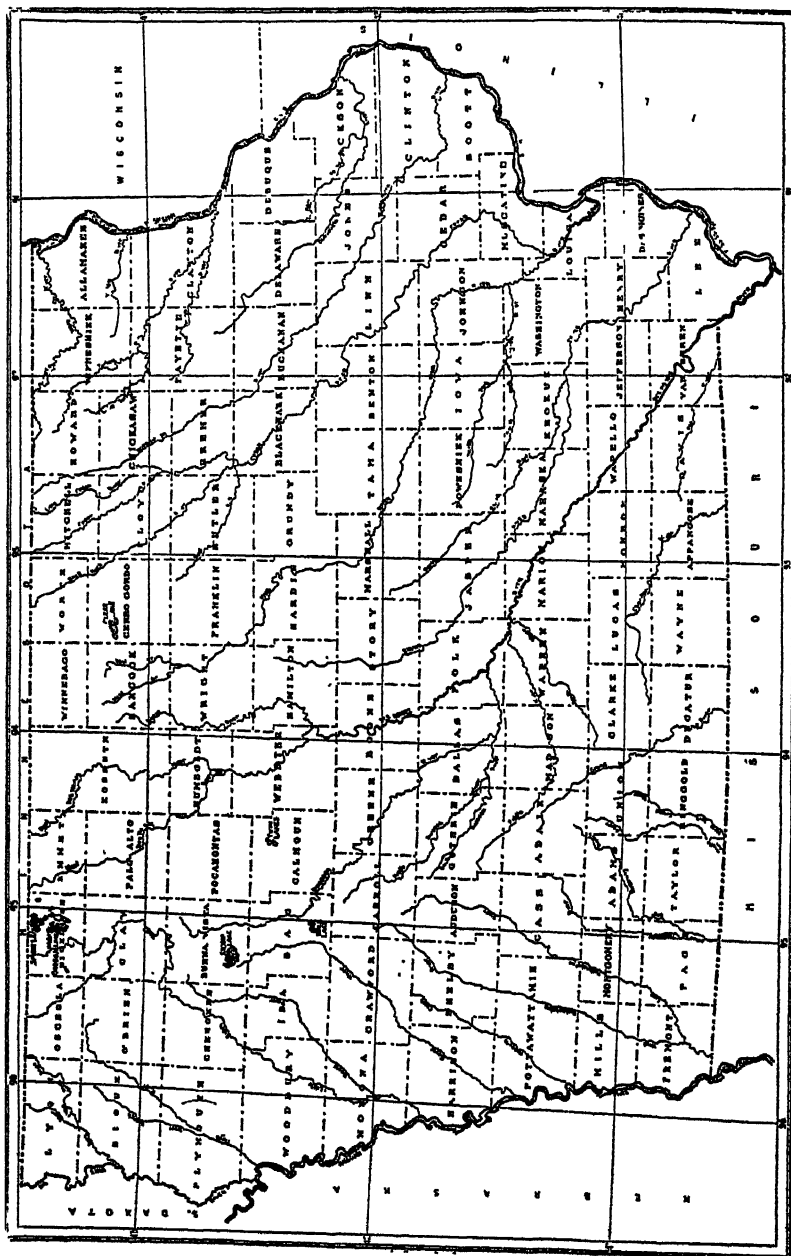
by

PHILIP A. DuMONT

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MAP OF IOWA

INTRODUCTION

It has been twenty-seven years since the "Birds of Iowa" was written by Rudolph M. Anderson (1907).¹ Three hundred and fifty-four species of birds were included in the list, and the physical features and climate of the state together with the distribution of bird life in Iowa, were discussed in some detail. This publication has been out of print for a period of years.

During the intervening years considerable changes have taken place in Iowa which have had an effect on the bird life. There has been a steady increase in population. The draining of lakes and tiling of marshy areas, in order to increase the acreage under cultivation, has resulted in destroying the feeding grounds and nesting areas of water-fowl. Improvement of the highways has made almost every hunting area in the state accessible to the motorist. While the numbers of water-birds, game-birds, hawks, and owls have been steadily decreasing, certain smaller birds such as the grackle and English sparrow have increased until they have crowded out some of the more desirable species.

The purpose of this paper is to present a complete list of the birds that have been found in Iowa, giving the status or relative abundance and distribution of each species. The nomenclature is that incorporated in the recently issued Check-List of the American Ornithologists' Union (1931).

HISTORICAL

The earliest records of bird life in Iowa are contained in the journals² of the Jesuit priest Marquette and his companion Joliet, who in 1673 journeyed down the Wisconsin River to its mouth and followed the Mississippi as far south as the Arkansas River.

A hundred and thirty years elapsed before the first of the several expeditions up the Missouri River were begun. Observations of birds

¹The date following an author's name is that of publication. By referring to the selected bibliography appended at the end of this paper, the full title of each publication may be found.

²The Jesuit Relations, Vol 59. Marquette and Joliet.

recorded in the reports of these explorations furnish the earliest records we have from this region. The first of these trips was by Lewis and Clark who ascended the river in 1804 returning in 1806. Thomas Say, a member of Major Long's expedition, spent the winter of 1819-20 at Engineer Cantonment, on the west side of the Missouri River, near the present site of Fort Calhoun, Washington County, Nebraska.

In 1820 Captain (later General) Stephen Watts Kearny³ accompanied a military detachment on an overland march from Council Bluffs to Camp Coldwater at the junction of the Minnesota and Mississippi Rivers and thence down the Mississippi to St. Louis. In 1824 Kearny left St. Louis with Brigadier-General Henry Atkinson on an expedition up the Missouri River and did not return for two years. His third excursion, made during 1835, was a march from "Keokuk's town" northwest along the Des Moines River to the present site of Boone, then north-eastward to Lake Pepin in south-eastern Minnesota. The return was by a similar route.

Prince Maximilian of Wied furnishes some notes on Iowa birds seen during his trip up the Missouri River in 1833 and during the return trip in 1834. John J. Audubon stopped at several Iowa points during his collecting trip up this river in 1843.

During the months of July, August, and September of 1867, J. A. Allen (1868) made a study of the bird life in western Iowa. Several days were spent at Boonesboro, in Boone County, and then moving westward he stayed a week at Denison, Crawford County. The remainder of the summer was utilized in almost continuous travel across Sac, Carroll, Greene, Dallas, Guthrie, and Audubon counties. Of the one hundred and eight or ten species observed, Allen concluded that at least one hundred undoubtedly were breeding in the state.

The first list of the birds of Iowa, written by Allen, was contained as an appendix in White's *Geology of Iowa* (1870). This unannotated list including 283 species was based in part upon his studies in Iowa. Only 93 species were indicated as having been observed by Allen; the remainder he concluded should occur as migrants, winter visitors, or as additional summer inhabitants. Eleven species, included by Allen, have not yet been satisfactorily proved to have occurred in Iowa. These are: Crested Grebe, Brant, Purple Gallinule, Purple Sandpiper, Knot, Red Phalarope, Black-backed Gull, Marsh

³The journals of Kearny, containing copious notes concerning the natural history of Iowa, were summarized by William J. Peterson in the *Palimpsest*, XII, No. 8

Tern [Gull-billed Tern], Richardson's Owl, Varied Thrush, and Baird's Sparrow.

A very valuable record of the early bird life of Decatur and Mahaska Counties is contained in "Notes on the Birds of Southern Iowa," by T. Martin Trippe (1873).

The narrative of John Krider, "Forty Years' Notes of a Field Ornithologist" (1879), contains many notes on Iowa birds. No doubt this account was responsible in inciting W. L. Abbott, of the Philadelphia Academy of Natural Sciences, to make two trips into northern Iowa, the first in 1879 and another in 1881.

In 1883 an added interest was given to ornithology in Iowa when Wells W. Cooke (1888), of the United States Biological Survey, organized a number of observers throughout the state for the purpose of studying bird migration. During 1883 four observers furnished reports to the Survey, and in 1884 this number was increased to twenty-six. In 1885 fifteen observers reported from Iowa, of which twelve were different than from those of previous years.

Several private collections of birds were started as a result of this program by the Survey. The one of Charles Rollin Keyes of Des Moines, partially served as the basis for the paper, "A Preliminary Annotated Catalogue of the Birds of Iowa," written by Keyes and H. S. Williams, in 1889. This list contained 262 species, noted mostly at Des Moines, Charles City, and Iowa City. Migration data and statements of abundance were based upon observations made at Des Moines.

The earliest bibliographical work on the birds of the state was written by Paul Bartsch in 1899 under the title "The Literature of Iowa Birds." While much material was selected from this paper by Anderson for use in the bibliography of his "Birds of Iowa" (1907) still the original has never been published.

In 1906 Rudolph M. Anderson wrote the "Birds of Iowa." As mentioned in this Introduction, his catalogue, the only comprehensive treatment of the birds of the state, contained a total of 354 species.

The "Two Hundred Wild Birds of Iowa" was written by Bert H. Bailey in 1910. This handbook was intended for the identification of the commoner species of birds to be found in the state and was adapted for use in the schools. "The Raptorial Birds of Iowa," the manuscript for which was nearly completed at the time of Bailey's death in 1917, was edited by Clementina Sinclair Spencer

and published in 1918. This Bulletin, still available through the office of the Iowa Geological Survey, Iowa City, treats of the forty species of hawks and owls known to have occurred in Iowa.

Numerous regional or county lists have been published from time to time in ornithological journals such as the *Wilson Bulletin*, the *Auk*, and the *Oölogist*. Others are contained in the *Iowa Ornithologist* and the *Western Ornithologist*, the journal of the Iowa Ornithologists' Association from 1894 to 1900. The more important of these papers are listed in the selected bibliography at the end of this report.

PHYSICAL FEATURES

The state of Iowa is located in approximately the geographical center of the United States, and lies between $90^{\circ} 15'$ and $96^{\circ} 43'$ west longitude and between $40^{\circ} 20'$ and $43^{\circ} 30'$ north latitude. The maximum length is about 320 miles while the nearly constant width north and south is 230 miles. The area of somewhat over 55,000 square miles is divided politically into 99 counties of more or less uniform size. Iowa is bordered on the east by the states of Wisconsin and Illinois, on the south by Missouri, on the west by Nebraska and South Dakota, and along the north by Minnesota.

The topography of the state is remarkably uniform, consisting of a broad level plain, with wooded areas along the streams and in the southeastern third of the state; the original prairie region of the northwest was devoid of natural timber. In the southern third of the state, an area untouched by either the Wisconsin or Iowa glacial drift, the terrain consists of a continuous series of low rolling hills. The entire eastern boundary of the state is formed by the Mississippi River, and the wooded bluffs bordering the river in the vicinity of McGregor attain a height of some 400 feet above the river-bed. The lowest altitudinal point in Iowa is at Keokuk, where the elevation above sea level is only 477 feet. The greatest elevation is near Sibley, in the northwestern corner, where an elevation of about 1,600 feet is reached. The Missouri River forms the western boundary of the state for two-thirds of the distance, the northern third following the course of the Big Sioux River. The water-shed between the Mississippi and Missouri Rivers is an irregular line, being approximately between Dickinson County in the north and Wayne County in the south, dividing the state unequally;

about two-thirds lies east of the water-shed and less than one-third to the west.

The climate of Iowa is that typical of the upper Mississippi River Valley region. The mean annual temperature of the state is 48°, with the mean in the southern portion being about 4° warmer than in the northern part. Extreme temperatures of 113° and —47° have been recorded but these are of infrequent occurrence. The mean annual precipitation is 32.15 inches, with a moderate increase in the southeast and slightly less in the northwest plains area.

FAUNAL AREAS

The concept of life zones as formulated by Dr. C. Hart Merriam in 1894 was based upon the temperature control of animals and plants in their distribution northward and southward. These life zones were still further divided eastward and westward, depending upon relative humidity, into faunal areas. These arbitrary divisions were selected by Merriam because areas containing certain peculiar genera of plants and animals could be more or less delineated by isothermic boundaries. Recent studies by Kendeigh⁴ and Shelford⁵ have shown that, "the life zone concept, in order to survive, must be based upon the actual distribution of important and significant animals and plants in nature and not upon climatic factors of uncertain preconceived importance."

The application of either the life-zone theory or the concept of plant-animal ecologic communities to the fauna and flora of Iowa achieves practically the same delineations. The factors of temperature and rainfall are sufficiently uniform in all parts of the state to prove of little consequence in effecting distribution. According to Merriam (4th Provisional Map of the Biological Survey, 1910) almost the entire state falls within the area designated as Upper Austral or Carolinian. Within the past two decades certain species of birds, considered as typical Carolinian indicators, such as Carolina Wren, Eastern Mockingbird, Blue-gray Gnatcatcher, Prothonotary Warbler, and Eastern Cardinal, have advanced so far northward along the Missouri and Mississippi River valleys, that they may now hardly be accepted as true guides of the limits between Upper Austral on the south and the Transition zone on the north. Likewise

⁴Wilson Bull., XLIV, pp. 129-143.

⁵*Ibid.*, pp 144-157.

the continued influx of the Western Burrowing Owl, Arkansas Kingbird, and Lark Bunting into the northwestern corner of the state may indicate a broad overlapping in this area between the Carolinian species and the dry plains forms, the so-called Upper Sonoran or Campestrian. It is certain that before the advent of settlers into Iowa a definite delineation of birds existed between the prairie province of the northwest and the wooded areas of the southeast. In the past half century the entire state has been so thoroughly developed for agricultural purposes, accompanied by the cutting of natural woodlands and the planting of groves throughout the plains country, that no pronounced differentiation remains between these former biotic areas.

CHANGE IN BREEDING SPECIES

During the last twenty-five years there have been some very noticeable changes in both the abundance and variety of the breeding birds in Iowa. The Trumpeter Swan, Whooping Crane, Passenger Pigeon, and Wild Turkey were all exterminated as breeders before 1900. The Passenger Pigeon was extinct everywhere shortly after the beginning of the century. There have been no records of the Trumpeter Swan even as a migrant since that date and there are only two reliable observations of the Whooping Crane since 1900. The last Turkey killed in Iowa was in 1904. However, some introduced stock has been recently planted in a few of the state parks. The Duck Hawk, while still occurring rarely as a migrant, has not nested in Iowa since 1898. The Wilson's Phalarope, formerly a numerous breeder in marshy areas of the northwest, disappeared about 1900. Recently it has reinhabited suitable areas in Minnesota and may be expected again in this state.

The Greater Prairie Chicken, Eastern Ruffed Grouse, Woodcock, Upland Plover, Northern Pileated Woodpecker, and Short-billed Marsh Wren all are represented by a few breeding birds but in greatly reduced numbers in recent years. It is difficult to explain the seeming disappearance of the Henslow's Sparrow. There have been no breeding records in a number of years.

With the disappearance of certain native species, perhaps unable to adapt themselves to the changing conditions brought about by settlement of the country, others have moved in or have been brought in to replace them. The Ring-necked Pheasant and European Partridge have been successfully introduced. The English Sparrow, after

moving into the state in the '70's (supplemented by local planting) and increasing until it became more numerous than any of our native species, may soon be forced to give way to the Starling, which already (1933) has moved half-way across the state in some numbers. The Bronzed Grackle appears to have increased in numbers as a breeding bird.

Five Carolinian species, the Red-bellied Woodpecker, Tufted Titmouse, Carolina Wren, Prothonotary Warbler, and Eastern Cardinal, have become more numerous and continued their spread northward. The Western Burrowing Owl, and Arkansas Kingbird have entered the state from the west and are increasing in numbers in northwest Iowa.

SCOPE OF THE WORK

There are included in this paper 364 species of birds that have been found in Iowa. An additional 18 species are contained in a Hypothetical List because of insufficient evidence for inclusion in the body of the paper. It is a generally accepted rule among ornithologists that no species of bird be admitted to a state list unless a specimen has been captured within the state and preserved, or critically examined by a competent bird student.

In the preparation of this paper several species included by Anderson in his "Birds of Iowa" have not been retained because: the records were based upon incorrectly identified specimens; the range of certain subspecies is now so delineated as to exclude them from the list without supporting evidence of specimens; in the case of rare or accidental species the record must be based on a specimen or on an acceptable field observation, by a person of recognized ability. These species which are removed from the main list but which may be expected to occur in Iowa, are included in the Hypothetical List and ornithologists are urged to record any additional evidence of their occurrence. All others are placed in an Appendix with a statement concerning their removal. A number of species have been recorded for Iowa based on the actual taking of the bird, but the specimen was either not saved or has since become lost. In the case of a rare species such records necessarily have received consideration over and above those based on field observations alone.

This list of Iowa birds contains 35 species and subspecies of birds not included by Anderson. A number of these have been recorded in various publications but the following 14 birds have not hereto-

fore been reported from Iowa and are based upon recent studies by the writer: Lesser Loon, Western Pigeon Hawk, Northern Bald Eagle, Western Mourning Dove, Arctic Horned Owl, Aiken's Screech Owl, Northwestern Shrike, Giant Red-winged Blackbird, Nevada Cowbird, Bendire's Crossbill, Western Tree Sparrow, Nevada Savannah Sparrow, Western Field Sparrow, and Dakota Song Sparrow.

Of the 364 species of birds recorded for Iowa 47 may be considered as permanent residents or as represented by at least a few individuals throughout the year, in some parts of the state, 136 have been found as breeding birds in Iowa during the past two decades, 29 are winter visitors, 148 are spring and fall migrants, and 39 are of casual or accidental occurrence.

COLLECTIONS

There are many collections containing Iowa birds and practically all of these have been examined by the writer during 1932 and '33. The Museum of Natural History, University of Iowa, Iowa City, contains the Frank Bond collection of birds secured in southeastern Iowa, the Paul Bartsch collection from Burlington and Iowa City during the '90's, the Rudolph M. Anderson birds from north-central and southeastern Iowa, and the Ira N. Gabrielson collection from central Iowa. The D. H. Talbot collection, secured from 1883 to '87, contains large series of species from northwestern Iowa. These proved of great value in the present study. The Museum contains numerous mounted birds as well as other Iowa material secured from time to time.

The Bert Heald Bailey Memorial Museum at Coe College, Cedar Rapids, contains a fine collection of mounted birds and a good series of study skins with data, secured principally by B. H. Bailey and W. F. Kubichek. This collection and the one of Oscar P. Allert at Giard contain the best series of recently taken specimens.

The collection of mounted birds at Iowa State Teachers College, Cedar Falls, and the Iowa State Historical Museum at Des Moines, both contain several specimens of interest as state records. The D. J. Bullock collection, secured in central Iowa, is loaned to the Washington Irving Junior High School, Des Moines. The birds secured by Charles Rollin Keyes in Polk County in the '80's are now in the Department of Biology, Iowa State College, Ames. A few Iowa specimens are contained in the group of mounted birds in the Parker

Museum, Grinnell College, Grinnell. A series of study skins in the Department of Biology of the college, was taken locally.

T. C. Stephens has a small series of study skins in the Department of Biology, Morningside College, Sioux City. The mounted collection of the Sioux City Academy of Science is contained in the Public Library in the same city. The H. B. Smith collection of birds from Sac County is now in the Odebolt High School. A few Iowa specimens are contained in the Davenport Public Museum, Davenport. The J. M. Shaffer collection containing several specimens from Jefferson County, is in the Jefferson County Library, Fairfield. Several specimens of birds from southeastern Iowa are in the Museum at Iowa Wesleyan College, Mt. Pleasant.

There are several private collections of birds in Iowa, the one of Oscar P. Allert of McGregor being outstanding. Other collections examined by the writer are those of: Miss Althea Sherman, National via McGregor; Harry Tennant, Arnold's Park; William Youngworth, Sioux City; Otto W. Remer, Le Mars; Walter Rosene, Ogden; Carl Fritz Henning, Boone Public Library; C. H. Schroeder, Des Moines; Frank E. Ellis, Maquoketa; and H. J. Giddings, Sabula. The A. J. Anderson collection secured in the vicinity of Sioux City, is now in the Pettigrew Museum, Sioux Falls, South Dakota. William E. Praeger wrote that part of his collection from Keokuk, was still in his possession at Kalamazoo, Michigan, but this material was not examined by the writer.

Another collection, outside of Iowa, is the one secured by J. Eugene Law in Dallas County, and now stored in the Museum of Vertebrate Zoology, Berkeley, California. These birds were examined during April, 1932. An important collection from the southeastern corner of the state was secured by Walter G. Savage in the '90's, and is now in the Dwight collection, American Museum of Natural History, New York City. This collection was examined in 1932 and subsequently J. T. Zimmer has re-examined certain specimens, and to him the writer expresses his appreciation. The material secured by W. L. Abbott in northern Iowa during 1879 and 1881, is contained in the Philadelphia Academy of Natural Sciences. Witmer Stone kindly forwarded a record of these specimens.

A collection of birds secured during the summer of 1907 in Clay and Palo Alto counties by Alexander G. Ruthven and Max M. Peet, members of the University of Michigan-Walker Expedition, is now in the University Museum at Ann Arbor, Michigan. J. Van Tyne,

Curator of Birds, has recently examined critically several of these specimens. The collections of the Biological Survey and the United States National Museum, Washington, D. C., contain a number of Iowa birds. Harry C. Oberholser has kindly supplied a record of these.

FIELD WORK

Questionnaires were sent to a number of bird students in the state for the purpose of recording the present status and distribution of bird life. The summaries of this information together with recently published local lists have been used by the writer to check with existing specimens and so determine the content of this paper. The following people, frequently mentioned in this paper by surname only, have contributed notes, for which acknowledgment is made herewith by the author: Oscar P. Allert of McGregor, Walter W. Bennett of Arnold's Park, Homer R. Dill of Iowa City, J. Wilbur Dole of Fairfield, Frank E. Ellis of Maquoketa, Paul L. Errington of Ames, H. J. Giddings of Sabula, James R. Harlan of Des Moines, George O. Hendrickson of Ames, W. F. Kubichek of Cedar Rapids, E. D. Nauman of Sigourney, Fred J. Pierce of Winthrop, F. L. R. Roberts of Iowa City, Walter Rosene of Ogden, Harry M. Sanderson of Des Moines, William Schuenke of Des Moines, Althea R. Sherman of National, Charles J. Spiker of Ypsilanti, Michigan, T. C. Stephens of Sioux City, B. O. Wolden of Estherville, and William Youngworth of Sioux City.

Anderson has reviewed the work done by Iowa bird students between the years 1880 and 1906. Notes concerning their observations and collections are contained in his report.

ACKNOWLEDGMENTS

The avifauna of Iowa has recently received but little attention with regard to presently recognized subspecies. Therefore it seemed desirable to have an accurate determination made of all forms of birds which might be represented by more than one subspecies occurring within the state. For the loan of specimens, the writer wishes to thank Oscar P. Allert of McGregor, William Youngworth of Sioux City, W. F. Kubichek of Coe College, Cedar Rapids, J. E. Guthrie of Iowa State College, Ames, H. W. Norris of Grinnell College, Grinnell, and John T. Zimmer of the American Museum of Natural History, New York. The writer acknowledges with pleasure the aid

of Alden H. Miller of the University of California, Berkeley, in the identification of a series of shrikes. A large series of birds was submitted to J. Van Tyne of the Museum of Zoology, University of Michigan, Ann Arbor, to whom the writer is indebted for aid in their determination. Other series were identified at the University of Iowa Museum by Harry C. Oberholser whose assistance is herewith acknowledged.

To Rudolph M. Anderson of the National Museum of Canada, Ottawa, and T. C. Stephens, Morningside College, Sioux City, the writer is indebted for advice in the preparation of this paper. In particular, mention should be made of the coöperation of Thomas S. Roberts, University of Minnesota, Minneapolis, Myron H. Swenk, University of Nebraska, Lincoln, and Rudolf Bennitt, University of Missouri, Columbia. Both Swenk and Bennitt are engaged in the preparation of new catalogues of birds in their respective states, while Roberts' splendid "Birds of Minnesota" has already been issued.

Appreciation is expressed to Miss Phyllis Moorcroft for assistance in correcting the manuscript.

THE BIRDS OF IOWA

Order GAVIIFORMES

Family Gaviidae

Gavia immer immer (Brünnich). Common Loon

A rare late fall and early spring migrant. This slightly larger Loon is the one found breeding in northeastern North America. There are three specimens in the University of Iowa Museum. No. 27530, a male in full breeding plumage, was secured at Fort Madison, Lee County, April 7, 1927. Measurements of this specimen in millimeters are: wing (measured across the chord), 370.8; exposed culmen, 89.9; height of bill at base, 29.2. No. 23308, a female in winter plumage, was taken at Iowa City, Johnson County, during November, 1909. It measures: wing, 368.3; exposed culmen, 74.9; height of bill at base, 25.9. The third specimen, No. 18571, is an immature female taken at McCook Lake, South Dakota, a few miles west of Sioux City, on November 11, 1902. Measurements are: wing, 370.8; exposed culmen, 81.3; height at base, 25.6.

Gavia immer elasson Bishop. Lesser Loon

A regular but uncommon spring and fall migrant along the larger rivers and lakes of the state, less numerous through the interior. Formerly bred in the northern part of the state. There are a number of Iowa specimens.

Gavia arctica pacifica (Lawrence). Pacific Loon

Accidental. This species was listed by Anderson (1907) under the name *Gavia arctica* (Linn.), Black-throated Loon. He included the following records: "Two specimens have been taken in Jackson County. J. Giddings reports (Iowa Orn., ii, 4, 1896, 73): 'Nov. 15, 1895, a male Black-throated Loon was shot while swimming in the Mississippi River a little way from the shore opposite Sabula, by Mr. W. Eldridge. Identified by Dr. C. Hart Merriam.' H. J. Giddings reports (West. Orn., v. 3, 1900, 60): 'On Nov. 26, 1899, an immature male was

shot on the Mississippi River at this place [Sabula] and sent to me for mounting.' A specimen in the University Museum, No. 10175, in juvenal plumage, was taken at Burlington; recorded by Prof. C. C. Nutting (Proc. Iowa Acad. Sci., 1894, 44)."

Subsequently, F. Seymour Hersey, while engaged in a critical review of all North American records of the Black-throated Loon, recorded (Auk, XXXIV, pp. 283-290) that his correspondence in connection with his investigation revealed that the specimen in the University of Iowa Museum could not be found. H. J. Giddings wrote him that the specimen secured November 16, 1895, was still in his possession and that the exposed culmen measured 2.15 inches, from which Hersey concluded it must be a Pacific Loon.

This mounted specimen was examined by the writer (Wilson Bull., XLV, pp. 89-90) on April 15, 1933, and found to be, unquestionably, referable to *Gavia arctica*. All North American records of this species south of Alaska are now referred to the subspecies *pacifica*. Measurements in millimeters of this male in winter plumage are: wing, 303.5; tail, 57.9; tarsus, 68.5; exposed culmen, 51.3; height of culmen at base, 13.7; height of culmen at nostril, 12.2; culmen from nostril, 38.8. It was shot by W. H. Eldredge on November 16, 1895, while it was swimming in the Mississippi River in front of the town of Sabula, Jackson County. This statement is slightly different than the one quoted by Anderson. However, these data have been recently verified by Giddings through reference to his journals. There are no other definite Iowa records.

Gavia stellata (Pontoppidan). Red-throated Loon

Very rare migrant. Anderson (1907) gives the following: "There are two Nebraska records, both males, taken on the Missouri near Omaha, one Sept. 28, 1894, another April 6, 1897, reported by I. S. Trostler (Rev. Bds. Neb., 1904, 7).

"County records: Blackhawk—'rare winter or fall visitor' (Peck). Franklin—'three years ago saw a flock on a small lake in Franklin county and secured two at one shot' ("Sea Birds that Visit Iowa," Iowa Orn., ii, 2, 1896, 32). Jackson—'very rare' (H. J. Giddings). Polk—'I mounted one which must have been a straggler. Although the party who shot it said there were others, he might have been mistaken' (Johnson)."

Morton E. Peck, October 12, 1932, wrote that he had never seen the Red-throated Loon in Iowa. H. J. Giddings, in a letter, October

11, 1932 said: "I have never had a specimen of Red-throated Loon."

Widmann (1907) lists the two Nebraska records and adds: "Mr. W. E. Praeger writes me that there is a mounted specimen in Keokuk said to have been shot on the Des Moines River near Ottumwa, Ia." In a letter October 26, 1932, Praeger said: "I think the record of the Red-throated Diver is good. I saw the bird but had to depend on the statement of the owner of the specimen that it was obtained near Ottumwa."

Several recent reports of the Red-throated Loon at Carter Lake, Pottawattamie County,⁶ Iowa, are contained in the monthly Letter of Information, edited by Myron H. Swenk, Secretary and Treasurer of the Nebraska Ornithologists' Union. One observed April 17 and 27, 1929 by Robert Overing. One in winter plumage was seen on April 22, 1930 by Mr. and Mrs. Overing. Five seen September 22 and 23, 1930 by Mary Ellsworth and L. O. Horsky.

Order COLYMBIFORMES

Family Colymbidae

Colymbus grisegena holboelli (Reinhardt). Holboell's Grebe

A rare migrant. Pierce (1930) recorded one seen April 25, 1926, at Independence, Buchanan County. Nauman reported two observations of it in Keokuk County; April 10 and 12, 1927, one individual seen each day on the city pond, Sigourney. DuMont recorded (Wilson Bull., XLI, pp. 191-192) it as a rare spring migrant in Dallas and Polk counties. Bennett (1931) listed it as rare in the Sioux City region. Roberts reported one at Orleans, Dickinson County, Sept. 9, 1928. A specimen is in the University of Iowa Museum.

The only evidence of former breeding of this species in Iowa is recorded by Fenton (1923-24) as follows: "Webster states that this species nested near Charles City in the '60's, but is now a very rare migrant." Roberts (1932) stated that young birds unable to fly have been taken at Heron Lake, Jackson County, Minnesota, which is only a short distance north of the Iowa line.

Colymbus auritus Linnaeus. Horned Grebe

Uncommon migrant. Stephens (1918) reported it as present in

⁶Carter Lake, a cut-off portion of the Missouri River, is five miles north of Omaha, on the Nebraska side of the present channel of the river. The Iowa state boundary follows the middle of this lake and politically the land included on the inner bend of the lake and southeast to the river is part of Iowa.

considerable numbers in the vicinity of Sioux City during the last two weeks of October and the early part of November, 1917. On October 21, 1917, A. J. Anderson collected four at Badger Lake, Monona County, out of a flock of approximately fifty.

The only breeding record for the state was listed by Anderson (1907). G. W. Walters of Cedar Falls had reported the Horned Grebe as an occasional summer visitant, and nesting in Blackhawk County. Roberts (1932) records nesting birds at Heron and Loon Lakes, Jackson County, Minnesota, in May, 1885 and June, 1900. There are no recent Iowa breeding records. A number of specimens are contained in the various collections.

Colymbus nigricollis californicus (Heermann). Eared Grebe

An uncommon migrant throughout the western half of the state, somewhat rare in the eastern portion. Bennett (1931) recorded this species as an uncommon migrant in the Sioux City region. He wrote that his records showed many more Eared than Horned Grebes seen in that locality. Wolden reported it as infrequent in Emmet County. Three records for Polk County were given by DuMont (1931). Kubichek considered this species more numerous in Linn County than the Horned Grebe. Roberts noted a single bird at Swan Lake, Johnson County, and a small flock at Amana Lake, Iowa County, during May, 1932. One in full breeding plumage was seen by Roberts and the writer at Mt. Pleasant, Henry County, May 6, 1933.

Anderson (1907) stated that B. H. Bailey found this species quite common at Eagle Lake, Hancock County, in July, 1902, being more numerous than the Pied-billed Grebe. Three adult specimens were shot there July 18-19, 1902, and many were seen leading their young. During June, 1903, Bailey took eggs and also photographed and shot birds. The writer knows of no recent breeding records.

Anderson (1907) states that Guy C. Rich secured a specimen of the Eared Grebe in Woodbury County. Spurrell (1917) recorded that a Sac County specimen was in the Smith collection. This specimen, a fully plumaged adult, is now in the Odebolt High School. In the Bullock collection there is a bird in winter plumage, taken during October, 1928 at Eagle Lake, Hancock County.

Aechmophorus occidentalis (Lawrence). Western Grebe

A rare migrant in the extreme western part of the state. The writer has been unable to find any Iowa specimens of this bird, but

the several sight records seem to justify including it in this list. Anderson (1907) gave the following records: "Two or three accidental specimens [individuals] noted in Blackhawk County in early spring. Recorded by my father, George D. Peck, the last time about seventeen years ago. The specimens were not taken, but his familiarity with Iowa birds is such that I think the record trustworthy' (Morton E. Peck). Dr. Trostler reports it as a rare migrant in Pottawattamie and Mills . . ." Widmann (1907) recorded that it had been taken near Omaha, Nebraska.

Roberts reports seeing a bird of this species in Dickinson County, August 8, 1926. In the Letter of Information of the Nebraska Ornithologists' Union, there are a number of recent reports of the Western Grebe at Carter Lake, the cut-off lake north of Omaha, on the Iowa-Nebraska state line. On October 9 and 10, 1926, two were seen. October 13, 1928, six were seen and two were observed on November 6, 1929.

Podilymbus podiceps podiceps (Linnaeus). Pied-billed Grebe

A common migrant and fairly common summer resident in all parts of the state, but decreasing in numbers as a breeding bird within the last fifteen years, due to the draining and drying up of so many ponds and marshes. There is a large series of Iowa specimens in the collection at Coe College.

Order PELECANIFORMES

Family **Pelecanidae**

Pelecanus erythrorhynchos Gmelin. White Pelican

A regular and at times common migrant along the western edge of the state, irregular and somewhat rare elsewhere. There are no breeding records. Bennett (1931) records it as a common migrant in the Sioux City area. Stephens (1930) records that for three days in the fall of 1921 (September 17, 18, and 19) H. R. Moen saw a very large flock of these birds on a bayou of the Missouri River near Onawa, Monona County. He estimated that the flock contained at least 5,000 birds. Reported by most of the earlier writers as common or abundant throughout the state, but at the present time this species is unreported by some of the observers from the central and eastern portions of the state. There are several Iowa specimens.

Pelecanus occidentalis occidentalis Linnaeus. Eastern Brown Pelican

Accidental. Anderson (1907) stated that the Brown Pelican was first recorded from Iowa by Thomas Say at Engineer Cantonment. The only other record is one by Carl Fritz Henning (Annals of Iowa, V, pp. 62-63) which is as follows: "Last week a Brown Pelican (*Pelecanus fuscus*) was captured by the Fritcher brothers on the Des Moines River, about nine miles northwest of Boone . . . first seen swimming in a bayou." This bird and its habitat were described in some detail in the *Boone Standard*, July 14, 1900.

This specimen, a fully plumaged adult, is now in the Boone Public Library and was examined by the writer June 14, 1932. In the A. O. U. Check-List, 4th Edition, this species is recorded from Kansas, Nebraska, Iowa, Illinois, etc.

Family *Phalacrocoracidae*

Phalacrocorax auritus auritus (Lesson). Double-crested Cormorant

A regular migrant along all of the rivers of the state and occasionally appearing in considerable numbers. This species appears to have increased somewhat within the last few years. There are numerous Iowa specimens.

Family *Anhingidae*

Anhinga anhinga (Linnaeus). Water-Turkey

Accidental. Anderson (1907) states: "The only known record of the occurrence of this species in Iowa was given me by Walter G. Savage in a letter of Feb. 25, 1904. He says: 'About twenty years ago one was killed in Henry County. This one is the only record that I have of any being in the state. I have no specimen; it was killed before I put up any, but I well remember the bird as being the Snakebird. It was killed on a little stream called "Little Cedar," in Henry County, Iowa, near Salem, and the man knew what a Cormorant was and so did I. It is a positive fact that a Snakebird was killed in Iowa.' Although reported by no other observers, Mr. Savage's long experience as a collector and observer of bird migrations makes this record appear an authentic one.

"This species was reported in Bruner's list as a Nebraska bird on the authority of a specimen shot supposedly near Omaha, but it has since developed that the bird may have been secured either in Iowa or Missouri (Rev. Bds. Neb., 21-22)."

Family **Fregatidae**

Fregata magnificens Mathews. Man-o'-war-bird

Accidental. Anderson (1907) gives the following records: "The Man-o'-war-bird is only an accidental visitant in Iowa. Morton E. Peck (Iowa Orn., ii, 2, 1896, 34) reports the occurrence of a specimen at LaPorte, Iowa (Blackhawk County), and Dr. Paul Bartsch told me of a specimen taken near Burlington, Iowa, by a gunner in the latter part of September, 1903, but as it was not known whether obtained on the Iowa or Illinois side of the Mississippi River, the latter may hardly be considered as an official Iowa record."

Relative to the above observation Morton E. Peck on October 12, 1932, wrote that the specimen was not taken, but that the bird observed could hardly have been anything but this species.

In the Auk (XXVII, p. 75), Henry K. Coale of Highland Park, Illinois, records that while passing through Burlington, Des Moines County, Iowa, he saw a mounted Man-o'-war-bird (*Fregata aquila*) in a store window. Upon inquiry he was told that the bird was killed in the spring of 1904. It was first noticed by some hunters as it flew along the Illinois shore of the Mississippi, who shot at it, when it turned and flew across the river into the city of Burlington where it struck an electric light wire and was killed. Coale believed it to be the first record for Iowa and for Illinois. Another occurrence, referred to by Anderson, was recorded by Paul Bartsch (Auk, XXXIX, pp. 249-250) who stated that on a visit to the Lone Tree Club, near Gladstone, Illinois, on October 10, 1903, he saw a mounted specimen of a Man-o'-war-bird. Inquiry revealed that the bird had been found in an exhausted condition on the Iowa bluffs of the Mississippi, immediately south of Burlington, in August of the same year, and although it had been fed, they had succeeded in keeping it alive for a few days only. He believed this to be the first Iowa record for the Man-o'-war-bird (*Fregata magnificens rothschildi*).

Order CICONIIFORMES

Family **Ardeidae**

Ardea herodias herodias Linnaeus. Great Blue Heron

A fairly common migrant throughout the state, more numerous along the Missouri and Mississippi Rivers. Records of breeding, at the present time, are scarce, although this heron is reported, generally,

as a summer resident. There has been a large breeding colony for a number of years south of Council Bluffs near Lake Manawa. While Iowa collections contain numerous specimens that are typical of this form there are a few which, in their lighter color and greater size, approach the next subspecies, but are not quite typical of it.

Ardea herodias wardi Ridgway. Ward's Heron

A rare visitor. Reported by H. C. Oberholser (Proc. U. S. N. M. 43, 1913, pp. 539-543) as breeding at Hillsboro, Henry County. This record is based on an adult male taken by Walter G. Savage, April 2, 1899, and now No. 12358 in the Dwight collection, American Museum of Natural History, New York City. Measurements of it in millimeters are: wing, 486; tail, 190; exposed culmen, 153; height of bill, 29; tarsus, 194; middle toe, 119. Another specimen, with the typical lighter colored neck and lighter back, is in the University of Iowa Museum. It is No. 16129, secured by Paul Bartsch at Burlington, Des Moines County, September 10, 1894, and it measures: wing, 498; exposed culmen, 158; height of bill, 30; tarsus, 199; middle toe, 111.5. Actual breeding evidence is wanting.

Casmerodius albus egretta (Gmelin). American Egret

Formerly a common late summer visitor, but absent for nearly twenty years. Recently reported at McGregor, Clayton County, in 1929; at Des Moines, Polk County, in 1930; and near Sioux City, Woodbury County, in 1931. During July, August, and September of 1932, it was reported from Woodbury, Emmet, Palo Alto, Dallas, Polk, Marion, Mahaska, Johnson, Louisa, Scott, Des Moines, and Clayton counties, with a maximum of twenty-one observed by J. W. Leuty in Marion County (DuMont: Iowa Bird Life, II, pp. 48-50). The egret may be expected in increasing numbers as a late summer visitor.

A specimen, No. 6074, in the collection of the Davenport Public Museum was taken by H. M. Manderville at Rockingham, Scott County. One in the museum at Iowa Wesleyan College, Mt. Pleasant, was collected at Burlington, Des Moines County. In the Shaffer collection at the Jefferson County Library, Fairfield, there are five specimens, but only two with data. One was shot on Cedar Creek, near Krum, Jefferson County, in 1897. Another was taken at Afton, Union County. A female in the Dwight collection at the American

Museum of Natural History was collected by Walter G. Savage at Hillsboro, Henry County, May 9, 1895.

Egretta thula thula (Molina). Snowy Egret

A very rare late summer visitor. Keyes and Williams (1889) list this species as very rare, having been taken at Des Moines and in Floyd County in August. Anderson quotes this record and gives the following county records: "Blackhawk—'an uncertain late summer and fall migrant from the south; young birds wander northward probably as soon as fledged. Sometimes appears in considerable numbers in Blackhawk County. One spring visitor, probably accidental, recorded' (Peck). Lee—'rare; mounted specimens without dates often seen' (Praeger); 'rare summer visitant. I think both the Snowy Heron and Little Blue Heron were present around Keokuk in August, 1891. I positively identified two young birds, male, shot' (Berry)." Morton E. Peck wrote that he saw the Snowy Egret in Blackhawk County on two occasions. A specimen was secured about 1885 and was mounted by his father, George D. Peck.

The only recent record is of a flock of thirty Snowy Egrets observed in northeastern Des Moines County during August, 1930, by Harold Holland of Galesburg, Illinois (Wilson Bull., XLII, p. 289). In a letter from Holland September 30, 1932, he says, ". . . I had numerous opportunities to observe them at comparatively close range, and so very distinctly with glasses that identification was not difficult. Personally, there is no other definite record for Iowa, although white 'cranes,' which may have been immature Little Blues, American, or Snowy Egrets, have at various times been reported."

There are no Iowa specimens with data.

Florida caerula caerulea (Linnaeus). Little Blue Heron

A rare late summer visitor. Keyes and Williams (1889) listed this species as rare. It had been observed during the summer in the eastern part of the state. Anderson (1907) gives two observations by Trostler near Omaha, June 15, 1897, and August 15, 1903. In addition he lists observations from Jackson, Lee, Linn, Mills, Pottawattamie, Van Buren, and Webster counties.

The Little Blue Heron was not noticed within the state for nearly twenty-five years. One of the first observations marking the return of this species as a late summer visitor was of two birds seen by

Leroy Titus Weeks south of McGregor, Clayton County, August 11, 1925 (Wilson Bull., XXXVII, p. 219). One was seen at Horseshoe Lake, south of Omaha, April 30, 1926, by C. A. Mitchell (Letter of Information of the Nebr. Orni. Union). Another observation near the Iowa line was by F. E. Musselman of Quincy, Illinois, who recorded (Auk, XLIX, pp. 78-79) watching more than thirty immature birds settle about a sand bar in the Mississippi River at Quincy, on August 30, 1931. Oscar P. Allert of Giard, reports seeing three Little Blue Herons at a pond near McGregor, Clayton County, during the last of August, 1932. The birds were in company with two Great Blue Herons allowing a satisfactory comparison of size. The greenish legs and dark coloration on the tips of the primaries were noted also. There are no Iowa specimens with data.

A specimen of the Louisiana Heron, *Hydranassa tricolor ruficollis* (Gosse), was killed near Sand Ridge, Clark County, Missouri, by E. S. Currier, April 13, 1890. There are no Iowa records.

Butorides virescens virescens (Linnaeus). Eastern Green Heron

A common migrant and fairly common summer resident, breeding throughout the state. There are numerous Iowa specimens.

Nycticorax nycticorax hoactli (Gmelin). Black-crowned Night Heron

Locally common as a migrant. There are numerous breeding colonies in the state.

Nyctanassa violacea violacea (Linnaeus).

Yellow-crowned Night Heron

Rare straggler. Anderson (1907) states: "Audubon, in his 'Journals' (ii, 481), under date of May 10, 1843, records two Yellow-crowned Night Herons near Council Bluffs. 'One was killed at Omaha, on the Iowa side of the Missouri, May 1, 1892, and recorded by I. S. Trostler, who also reported one near Florence Lake Aug. 23, 1903' (Rev. Bds. Neb., 34). Other Iowa records are as follows: Boone—'rare; only one record of its occurrence in the county. I have the specimen' (Henning). Jackson—'have a record of a specimen taken Sept. 15, 1892—Sabula' (Giddings). . . ."

The only recent observations were recorded by DuMont (1931). An adult was seen in Polk County by A. T. Watson, May 28 and 30, 1927. An adult male, No. 101,406 in the U. S. National Museum, was collected in Lee County, June 2, 1882.

Botaurus lentiginosus (Montagu). American Bittern

A rather common migrant and an uncommon breeding bird most numerous in the northwestern portion of the state.

Ixobrychus exilis exilis (Gmelin). Eastern Least Bittern.

An uncommon migrant, somewhat rare as a breeding bird. Tinker (1914) stated that it was a quite common breeder in Clay and Palo Alto counties. Rosene reported this bird as a fairly common breeder in Boone County, Hendrickson classed it as a summer resident, fairly common in Story County, Spiker in Chickasaw County and Roberts in Dickinson County reported this species as rare. However, this bird was not found by Allert in Clayton County nor by Nauman in Keokuk County. There are Iowa specimens in most of the collections in the state including a series of eight in the Coe College Museum and eight in the University of Iowa Museum.

A detailed account of the observations by Mary L. Bailey of Cory's Least Bittern, *Ixobrychus neoxenus* (Cory), at McCook Lake, Union County, South Dakota, and at Spirit Lake, Dickinson County, Iowa, is recorded in the Bulletin of the Iowa Ornithologists' Union, VII, No. 7, pp. 33 and 36. This alleged species is now regarded as a melanistic form of *Ixobrychus exilis* (Gmelin), and has been transferred to the Hypothetical List of the last A. O. U. Check-List.

Family Ciconiidae

Mycteria americana Linnaeus. Wood Ibis

Straggler. The only observation made in Iowa was recorded by Wallace B. Grange (Wilson Bull., XLIV, p. 43) as follows: "On the morning of September 8, 1931, while I was approaching the village of Mondamin, Harrison County, Iowa, from the south, I saw a flock of at least two hundred Wood Ibises (*Mycteria americana*), which had apparently just taken flight from along the Missouri River. The exact site where the birds were first seen was one-half mile from the village. They rose in two large groups, which later joined to form one large flock. . . . I had a splendid opportunity to observe them through glasses, and at reasonable range. . . . I was surprised to encounter these birds, with which I have been familiar in Florida, under the circumstances mentioned. I believe this is the first Iowa record." One was reported (Swenk, Letter of Information) near Omaha in 1925, and it has also occurred in Missouri, Illinois, and Wisconsin.

Family **Threskiornithidae***Plegadis guarauna* (Linnaeus). White-faced Glossy Ibis

A rare straggler. Records of this species in the Mississippi Valley, based on specimens of birds in juvenal plumage, have frequently been recorded as *P. autumnalis* = *falcinellus*. It seems evident now that there are no substantiated records of the Eastern Glossy Ibis for this area. Anderson (1907) lists the following records under *P. autumnalis*: "Kumlien and Hollister record it from Wisconsin . . . 'We have positively seen this bird on the Mississippi near Prairie du Chien in August some twenty years ago' (Bds. Wis., 1903, 32-3). 'A specimen taken near Omaha, Bruner thinks at Cut-off Lake, is in the University museum' (Rev. Bds. Neb., 1904, 31). County records: Boone—'Accidental visitor. Only one Ibis was ever taken in this county that I know of. It was identified as the Glossy Ibis, but it may have been *Plegadis guarauna*' (Henning); Woodbury—Recorded from Sioux City by Dr. Guy C. Rich (Iowa Orn., i, 2, 1895, 49). In a letter he says: 'I have an immature specimen mounted; shot in Nebraska just across the river, Oct. 1, 1893. It is an immature bird, *i.e.*, the head and neck are speckled; no white shows on forehead'." This specimen is now in the collection of the Sioux City Academy of Science.

Under *P. guarauna* Anderson recorded a specimen in the University of Iowa Museum, No. 4839, taken by B. F. Osborn near Rippey, Calhoun County, in April, 1891. Osborn reported that there was a flock of thirteen but only one was secured. The specimen, a fully plumaged adult, remains in the University of Iowa Museum. In addition Anderson cited the 1894 and 1895 breeding records of this species at Heron Lake, Minnesota, a short distance north of the Iowa line.

An immature specimen in the collection of Oscar P. Allert at Giard, was taken at McGregor during September, 1905, and probably is of this species. Another specimen in juvenal plumage is in the collection of Harry Tennant of Arnold's Park, and was secured at Lake Okoboji about 1917.

Order **ANSERIFORMES**Family **Anatidae***Cygnus columbianus* (Ord). Whistling Swan

Fairly rare migrant. Numerous records are contained in Anderson's list (1907) indicating that the distribution of this bird was statewide

and it formerly appeared in somewhat greater numbers than at present. Youngworth (Wilson Bull., XLIII, pp. 151-152) records one taken near Council Bluffs, Pottawattamie County, early in November, 1929; one near Castana, Monona County, during October, 1930; two immature swans killed October 20, 1930, on a sandbar in the Missouri River about a mile or two above the mouth of the Big Sioux River. These birds were reported by other observers as Trumpeter Swans. They were examined, however, by T. C. Stephens and found to be *columbianus*. Schuenke reports one killed near Paullina, O'Brien County, in 1930. Pierce (1930) records one shot by Independence hunters, probably about 1918. DuMont (1931) records two specimens taken in Polk County about 1912 and one secured in Dallas County in 1902. Roberts (1932) records that flocks of considerable size were seen by Abe Nelson in 1917 passing Heron Lake, Jackson County, Minnesota, both spring and fall.

Most of the state collections contain one or two of these swans. Two specimens recently taken, contained in the University of Iowa Museum are: a male, killed by George D. Nelson, March 30, 1921 at Osage, Mitchell County, and confiscated by federal agents; and a specimen killed by Herbert Dill, October 27, 1931, at Amana Lake, Iowa County.

Cygnus buccinator Richardson. Trumpeter Swan

Extinct in Iowa. Rather full details of the nesting of this species at Little Twin Lakes, Hancock County, as observed by J. W. Preston, in 1883, are contained in Anderson's list (1907). On March 22, 1904, Preston wrote Anderson as follows: ". . . This was positively *Olor buccinator*. The nest was placed on a large tussock in a marshy slough or creek, and had been used for years by the swans, as I was credibly informed; but the nest mentioned above, so far as I am aware, was the last in that locality. During the earlier days the Trumpeter Swan was not an uncommon summer resident, being occasionally found nesting in some remote and hidden place, and as late as 1875 there were a few pairs known to breed on the headwaters of the Des Moines River." Several county records are given by Anderson. However, there may be some doubt regarding field observations of this species in the eastern part of the state after 1890.

A mounted specimen of the Trumpeter Swan, collected by H. B. Smith in Sac County is now in the Odebolt High School. It was

examined by the writer September 3, 1932. It is probably the only Iowa specimen now preserved.

Branta canadensis canadensis (Linnaeus). Common Canada Goose

A fairly common migrant over the entire state, more numerous along the Missouri River Valley. Reported formerly as an abundant migrant and an uncommon breeding bird in Iowa. The only recent breeding record is reported by Wm. Schuenke who stated that one pair was known to have bred in northwestern Iowa during 1932. It seems advisable to withhold the exact locality.

There are numerous Iowa specimens.

Branta canadensis leucoparcea (Brandt). Lesser Canada Goose

A rare migrant, if occurring at the present time. Unfortunately there has been much confusion of names in the *canadensis* group. This subspecies, *leucoparcea*, is the medium-sized Canada Goose, intermediate in size, and actually overlapping in the range of measurements between *canadensis* and *hutchinsi*. The University of Iowa Museum formerly contained the collection of 593 specimens of Canada Geese secured by D. H. Talbot and his collectors during 1884-86 in Nebraska, the Dakotas, Texas, and northwestern Iowa. In 1923 thirty-two specimens were given in exchange to the U. S. Biological Survey. Fortunately a record of this large series has been preserved in a thesis written by Frank Russell at the University of Iowa in 1892. This dissertation entitled "Variation of Birds in a State of Nature," contains measurements of 500 of the specimens, most of them being from Nebraska. Of the 26 Iowa specimens five only are referable to *B. c. canadensis*; nine are *B. c. leucoparcea*, and twelve are the small *B. c. hutchinsi*. Data on the nine specimens of *leucoparcea* are as follows:

Museum No.	Locality	Date	Sex	Wing	Culmen	Tarsus
6730	Wolf Creek Slough	Apr. 14, 1884	male	419.1	38.6	76.2
6538	Wolf Creek Slough	Apr. 16, 1884	male	406.4	38.1	81.3
6580	Whiting	--- -- ---	female	393.7	35.6	71.1
6550	Sloan	Apr. 14, 1884	male	381.0	38.1	63.5
5104	Sioux City	Dec. 11, 1885	female	381.0	43.2	71.1
6459	Sloan	Apr. --, 1884	male	393.7	34.5	68.6
6726	Whiting	Spring 1885	male	390.4	37.8	----
6630	Whiting	Mar. 23, 1886	female	393.7	40.6	----
7953	Whiting	Apr. 3, 1885	--	-----	----	----

Nos. 6730 and 6459 are now in U. S. Biological Survey collection. Sioux City, Sloan, and Wolf Creek Slough are in Woodbury County; Whiting is in Monona County.

Under *B. c. "hutchinsi,"* the former name, Anderson gives a number of county records which presumably are now referable to this form. However, he listed no observations of the smaller subspecies, a condition quite at variance with present ideas of comparative abundance.

Under Hutchins's Goose (which would now refer to this race) Spurrell (1917) records that C. O. Lee reported it tolerably common both in early days and at the present time.

I know of no other specimen taken within the state or of any recent observations.

Branta canadensis hutchinsi (Richardson). Hutchins's Goose

An uncommon migrant. Data on the twelve specimens of *B. c. hutchinsi* formerly in the Talbot collection, referred to above, are as follows:

Museum No.	Locality	Date	Sex	Wing	Culmen	Tarsus
6586	Whiting	Apr. 6, 1886	male	371.6	33.0	68.6
6724	Wolf Creek Slough	Apr. 5, 1884	male	355.6	35.6	71.1
7994	Whiting	Apr. 7, 1885	female	373.4	33.0	64.8
8091	Whiting	Apr. 7, 1885	female	358.9	35.0	73.7
5077	Whiting	--- -- ----	--	339.6	33.0	66.0
6546	Wolf Creek Slough	Apr. 5, 1883	female	360.7	33.3	63.5
6447	Sioux City	--- -- ----	--	279.4	38.1	68.6
5116	Whiting	Apr. 7, 1885	female	368.3	---	---
6543	Whiting	Apr. 7, 1885	--	365.2	31.8	---
5344	Whiting	March 23, 1886	female	----	---	---
7988	Whiting	Apr. 2, 1885	--			
6728	Near Sloan	Apr. --, 1884	female			

Nos. 7994 and 6546 are now in U. S. Biological Survey collection.

Spurrell (1917) gives the status of the three forms in Sac County as follows: "Mr. Lee reported that the Cackling [now Hutchins's] was more common than the Hutchins's [now Lesser Canada] in early days and is more common than either Hutchins's [Lesser Canada] or Canada at the present day." James R. Harlan reports this form as an uncommon migrant in Polk County and DuMont (1931) records a flock of between fifty and seventy-five seen by D. J. Bullock in Story County during October, 1927. Two specimens were secured. In 1930 Wm. Schuenke examined one of these birds that was crippled

near Sioux City. In a letter from E. L. Vennard of Sioux City on January 16, 1933 he gives the status of the various geese in the Sioux City region as follows: "In the autumn months the Canadas seem to predominate, but in the spring migration the Blues are here in thousands, and in this latitude I believe these two varieties lead, with the Canada most common. The next would probably be the Hutchins's, then the White-fronted or 'Speckle' and the least common the Lesser Snow."

Besides the specimens listed above there is one in the Bullock collection in Des Moines, and two in the collection at Coe College, Cedar Rapids.

Anser albifrons albifrons (Scopoli). White-fronted Goose

An uncommon migrant in the northwestern part of the state and along the Missouri River, rare in the rest of the state, except along the Mississippi at McGregor where Allert reports it as an uncommon migrant. Spurrell (1917) lists this bird as tolerably common in Sac County. This species was unreported by several of the observers in the state.

Thirty-four Iowa specimens were contained in the Talbot collection. These birds were secured during March and April, 1884-85-86, in Woodbury and Monona counties.

Chen hyperborea hyperborea (Pallas). Lesser Snow Goose

A fairly common migrant along the Missouri River Valley, particularly near Sioux City. Uncommon or irregular in migration over the other portions of the state. Allert reports it as an uncommon migrant in Clayton County. Ellis considers this bird a common spring and fall migrant in Jackson County. Hendrickson reports it as an irregular migrant in Blackhawk County. Nauman reports this species as rare, but seen occasionally in Keokuk County. Rosene states that it is irregular in Boone County. Bennett (1931) records it as common at Sioux City.

Anderson (1907) summarized the measurements of seventy-eight specimens of the Snow Goose secured by D. H. Talbot and his collectors in the Missouri River Valley between 1884 and '86. All of these specimens are now considered to be referable to this race, *C. h. hyperborea*. The Greater Snow Goose, *C. h. atlantica* Kennard, is now restricted in range to the Atlantic Coast region with no records of occurrence in the interior.

Besides the Talbot specimens which, unfortunately, were not preserved, there are numerous Iowa specimens.

Chen caerulescens (Linnaeus). Blue Goose

A recently common migrant along the Missouri River Valley in the spring, less numerous during the fall migration. Uncommon or rare in other parts of the state. Allert reports it as an uncommon migrant in Clayton County. Rosene classes it as an irregular migrant in Boone County. Harlan considered this species the most common migrating goose in Polk County in 1931. Spurrell (1917) states that Mr. Lee considered them rare, reporting about one hundred Snow Geese to one Blue Goose. Spurrell did not consider this bird rare in 1915 when he reported seeing them several times, and on April 2, 1915, watching a flock on the Boyer River, Sac County, that contained at least two thousand Blue Geese. In a letter from E. L. Vennard of Sioux City, on January 16, 1933, he writes that there are thousands of Blues around there in the spring, perhaps one Snow Goose to every thirty or forty Blues. Walter M. Rosene and Walter W. Bennett record (Wilson Bull., XL, p. 199) observations of large migrating flocks of geese seen across the Big Sioux River west of Sioux City, Iowa, on March 14, 1928. Their estimate of the numbers seen were: White-fronted, 2; Blues, 3805; Lesser Snows, 668; Canadas, 2386; and unidentified geese, 316. T. C. Stephens records (*ibid.*, pp. 199-200) the numbers of geese observed, while on a trip with William Youngworth, twenty miles south of Sioux City, March 18, 1928. Flocks of Blue Geese estimated at 1500, 250, 500, 4,000, 300, and 4,000 were seen and of the Lesser Snows 6, 100, 40, and 100 were observed. The two large flocks of Blue Geese, aggregating at least 4,000 each, were at rest in a shallow slough or mud flat, and with them was a flock of 100 Snow Geese in each instance. Walter Thietje of Iowa City, observed the spring flight of these geese at Whiting, Monona County, during March of both 1932 and '33. He reported the Blue Geese present by the thousands, most numerous in 1932. One huge flock resting in a corn field was estimated to cover an area of at least fifteen acres. Of the two species present Thietje estimated that for each Lesser Snow Goose there were at least 250 Blues.

The University of Iowa Museum contains a series of 37 Blue Geese, of which 30 were taken by Walter Thietje near Whiting, Monona County, on March 26-27, 1932 and between March 17 and 23,

1933. A male, taken March 21, 1933, appears to be a hybrid between *Chen caerulescens* and *Chen h. hyperborea*. The general coloration is white, suffused with much rusty stain. The fresh feathers of the neck and back are grayish-blue. The basal half of the black-tipped primaries are gray while the secondaries are dull grayish on the terminal third, changing to white basally. The coverts display color values similar to the Blue Goose, the primary coverts are gray, the greater coverts white, the middle coverts are dark gray, and the lesser coverts are pale gray. The markings of the tertials are as in the Blue Goose with the dark gray feathers lighter on the inner and outer webs. The brownish-gray rectrices are greatly worn.

Anas platyrhynchos platyrhynchos Linnaeus. Common Mallard

A common migrant, wintering occasionally or remaining until the rivers and lakes are frozen over. Formerly an abundant breeder but at the present time nesting only in small numbers in all parts of the state, most numerous in the northwest. Without doubt, this is the most abundant migrating duck through the state, as well as the most important game bird.

Anas rubripes rubripes Brewster. Red-legged Black Duck

A very uncommon migrant. Allert reports it as a tolerably common migrant in Clayton County. Spiker reported it as a rare migrant in Chickasaw County. Youngworth considers it uncommon at Sioux City. Recorded by DuMont (1931) as an uncommon migrant, with dates of occurrence recorded for March, April, and May. One specimen is listed. Harlan reports this species as uncommon in Polk County. Rosene reports it as rare in Boone County. Hendrickson states that this bird is a straggler in central Iowa, with one observation at Little Wall Lake, near Jewell, Hamilton County, in 1931. Nauman reports it as rare, very few seen in Keokuk County.

A number of specimens have been recorded recently from the Sioux City region. Of three Black Ducks in the collection of the University of Iowa Museum all are referable to this subspecies. Three Iowa specimens in the collection at Coe College are definitely *Anas r. rubripes*, a fourth appears to be intermediate between *rubripes* and *tristis*. The throat is nearly unmarked in this specimen, but in size it approaches the Red-legged variety. It is No. 260, a male, taken by F. L. Fitzpatrick, November 1, 1916, at Britt, Hancock County, and measures: wing, 264.2; tail, 92.9; culmen, 52.8; tarsus, 41.7.

Chaulelasmus streperus (Linnaeus). Gadwall

A fairly common migrant in the Missouri River Valley, less numerous in the other parts of the state. Bennett (1931) records this species as a common migrant at Sioux City. Allert classes it as a fairly common migrant in Clayton County. However, several observers in the state have reported the Gadwall as a rare migrant.

Anderson (1907) lists three records of breeding in Kossuth County during 1901 and the succeeding few years. Widmann (1907) says that they used to be summer residents in northern Missouri, and that only a few years before were considered rare breeders in Clark County, Missouri by E. S. Currier of Keokuk. There are no recent nesting records.

Mareca americana (Gmelin). Baldpate

A fairly common migrant along the Mississippi and Missouri Rivers, less numerous through the interior. There are no known breeding records for Iowa.

Dafila acuta tzitzihua (Vieillot). American Pintail

A common spring migrant along the Mississippi, Des Moines, and Missouri Rivers, fairly common along the smaller streams and on the lakes of the state, somewhat less numerous during fall migration.

Anderson (1907) cites former breeding records in Hancock and Boone counties. Spurrell (1917) records this species as formerly breeding in Sac County. Summer records are listed by Anderson for Winnebago County. DuMont (1931) gives records of June 10, 1928, June 6, 1929, and August 25, 1929, for this species in Polk County. Leopold (Outdoor America, 1932-33) reports the Pintail as breeding in Allamakee County. Logan J. Bennett reports breeding records during 1932 and 1933 in Clay, Palo Alto, Emmet, and Dickinson counties.

Nettion carolinense (Gmelin). Green-winged Teal

A fairly common migrant, occasionally wintering. This species undoubtedly has been reduced in numbers in recent years as all of the early writers considered it an abundant migrant. At the present time it is exceeded in numbers by the Mallard, Blue-winged Teal, Pintail, and the Lesser Scaup.

Keyes and Williams (1889) stated that this species bred about the grassy marshes. Anderson (1907) recorded no breeding records.

Spurrell (1917) said that C. O. Lee found the Green-winged Teal nesting until about 1883 in Sac County. Lester P. Fagen (Proc. Iowa Acad. Sci., XVI, p. 213) recorded this species as breeding in Polk County. Leopold (Outdoor America, 1932-33) stated that this bird had bred in Emmet and Woodbury counties since 1920. Roberts (1931) recorded that there have been no nests found in Minnesota in recent years, but, as pairs are occasionally seen in the nesting season, it is probable that it still breeds occasionally in the state.

Querquedula discors (Linnaeus). Blue-winged Teal

A common migrant and, at the present time, the most numerous breeding duck in the state. The Blue-winged Teal has been recently reported as breeding in Allamakee, Clayton, Palo Alto, Emmet, Dickinson, Clay, Sac, Woodbury, Polk, Keokuk, and Johnson counties, and in all probability a few may be found in all parts of the state during the breeding season. Logan J. Bennett, who has been engaged in a study of the breeding ducks in northwest Iowa wrote that at least 80 per cent of Iowa's ducks are reared in Clay, Palo Alto, Emmet, and Dickinson counties (the counties being named in order of their waterfowl importance), and that Blue-winged Teal by far out-number the other breeding ducks in this area. Pierce (1930) considers this species the most common duck in eastern Iowa, away from the Mississippi. It is the opinion of the writer that during migration in the northeast this teal is exceeded in numbers by both the Mallard and the Lesser Scaup, and likewise in the northwest by the Mallard, Lesser Scaup, and the Pintail.

Querquedula cyanoptera (Vieillot). Cinnamon Teal

A rare straggler from the west. Anderson (1907) included this bird on the basis of the following county records: "Blackhawk—'migrant; specimen mounted by myself in museum I. S. N. S.' (Walters). Jackson—'Sabula—rare; have had hunters tell me they had shot it a few times' (Giddings). Pottawattamie—Mills—'I saw two that were killed by sportsmen April 8, 1894, at Big Lake (Pottawattamie), and several more that were killed in Mills County March 26, 1897 (south of Manawa Lake)' (Trostler). Woodbury—'There have been three or four birds shot in the neighborhood of Sioux City, but whether in the state I can't say. I have only one measurement, from a Nebraska bird shot in April, 1897' (Rich)." Walters stated that the

Blackhawk County specimen was never in the museum of the State Teachers College, but that it was mounted for a hunter.

J. A. Spurrell (1917) recorded the following observations from Sac County: "I identified one among many other ducks in the 'Goose-pond' April 18, 1915. It was resting and preening its feathers on the top of a haystack bottom surrounded by water. I had ample opportunity to observe it through eight power binoculars, getting all identification marks. Mrs. George May also reported it in the spring of 1911 and a local hunter in the fall of 1915, both observations in the 'Goose-pond'." H. M. Sanderson of the State Fish and Game Commission reported seeing a large flock of Cinnamon Teal on a slough south of Sioux City, Woodbury County, in either 1925 or '26. He reported a few seen near Council Bluffs, Pottawattamie County, in the fall of 1932. E. L. Vennard of Sioux City wrote as follows: "The Cinnamon Teal I had mounted was taken at McCook Lake, near this city, about 1924, but of course that lake is just across the line in South Dakota." Rosene observed one of these birds in Boone County, during 1932. Nauman reported one seen at Sigourney, Keokuk County, April 30, 1927. Roberts (1932) listed several Minnesota records for this species. It has occurred as well in all the states of the Mississippi Valley and as a straggler east to New York and South Carolina. The writer has been unable to find an Iowa specimen.

Spatula clypeata (Linnaeus). Shoveller

A common migrant in most parts of the state; reported by some observers as uncommon or even rare. However, the abundance of any water-fowl in a locality may be expected to vary according to the type of suitable cover available.

Anderson (1907) stated that there were no authentic records of this species nesting in the state. A number of occurrences during May and June were recorded as well as a statement by Carl Fritz Henning that it used to breed in Boone County. Spurrell (1917) stated that the Shoveller probably nested in Sac County in 1915. W. E. Praeger (Auk, XLII, 572-3) stated: "They probably bred at the Gooseponds in Clark Co., Mo. I have a note of three males there on June 6 and others have seen them in summer." The writer recorded (Wilson Bull., XLIV, p. 172) the observation of two males on June 3, and one male on June 6, 1929, from which he concluded that they likely were breeding in Boone and Polk counties. However, no nests were found. Allert reported that downy young had been

seen recently in Clayton County by Charles Brooks of McGregor. Leopold (Outdoor America, 1932-33) stated that this species had been reported as breeding in Palo Alto, Woodbury, and Allamakee counties since 1920. Logan J. Bennett wrote from Ruthven, Palo Alto County, during May, 1933: "There are many Shovellers nesting here. Last year I found only one nest, due to the fact that I arrived at the end of the nesting season."

Aix sponsa (Linnaeus). Wood Duck

Rare summer resident; greatly reduced in numbers since 1890. Within the past few summers this bird has increased somewhat as a breeding bird, particularly in the Upper Mississippi Wild Life Refuge in northeastern Iowa. Allert considers it a fairly common summer resident in Clayton County at present. Ellis has reported the Wood Duck as rare in Jackson County and likewise has Hendrickson in Blackhawk County, Nauman in Keokuk County, and Pierce in Buchanan County. DuMont (1931) records several recent observations in Polk County of which one in June and one in July probably refer to breeding birds. There are a number of recent reports from the Sioux City region. Leopold (Outdoor America, 1932-33) states that the Wood Duck has been found as a breeding bird in Allamakee, Clayton, Woodbury, and Polk counties since 1920. Fitzpatrick (1921) lists this species as breeding in Johnson County during 1915. He concludes that at one time the Wood Duck nested in all parts of the state. In a recent article (Wilson Bull., XLIV, p. 182) E. L. Breitenbach of Washington, Iowa says: "There are not as many Wood Ducks hatching here as there used to be, but there are some remaining about the Pinoak Ponds whenever we have water to keep the ponds full." During October, 1931, Breitenbach estimated there were from 400 to 500 Wood Ducks on the upper part of the Conesville marsh, Louisa County.

Nyroca americana (Eyton). Redhead

A fairly common migrant in the Missouri River Valley, uncommon along the Mississippi, and uncommon or rare through the interior of the state. Greatly reduced in numbers within recent years.

Cooke (1888) recorded this species as breeding at Clear Lake, Cerro Gordo County, in 1885. Logan J. Bennett wrote that G. A. Ammann and he found a nest containing 8 eggs at Mud Lake, Clay

County, May 30, 1933. Another at Green Slough, Clay County, found June 6, 1933 contained 11 eggs. They estimated there were twenty-five nesting pairs of Redheads in Clay County.

Nyroca collaris (Donovan). Ring-necked Duck

A common migrant in all parts of the state, although some observers have reported it as uncommon or even rare. This species is somewhat less numerous than the Lesser Scaup with which it is almost invariably associated while in migration.

The only instance of this bird as a breeder in Iowa was listed by Cooke (1888) who said that it was reported breeding at Clear Lake, Iowa, and thence northward.

Nyroca valisineria (Wilson). Canvas-back

A fairly common migrant, most numerous along the larger rivers of the state. Considered by a number of the observers in the state as rare at the present time. The Canvas-back appears in numbers about equal to that of the Redhead, both of which are noticeably less numerous than the Lesser Scaup and Ring-necked Duck.

Anderson (1907) stated that individuals may linger late in the spring. Recently DuMont (Wilson Bull., XLIV, p. 171) reported a pair seen in Hamilton County on June 11 and 12, 1928. However, there are no authentic breeding records for the state.

Nyroca marila (Linnaeus). Greater Scaup Duck

A rare migrant. The writer, while engaged in securing data for this paper, has critically examined nearly forty collections of birds containing Iowa material. Only a single Iowa specimen of *marila* has been found, thereby confirming the opinion of Roberts (1932, p. 260) and others that the Greater Scaup Duck is of rare occurrence through the Mississippi Valley. Roberts lists only three specimens for Minnesota. Somewhat over fifty Iowa specimens have been examined and all are referable to *Nyroca affinis* except a single female, No. 1472, in the collection at Coe College, Cedar Rapids. This specimen, taken by A. M. Bailey on November 15, 1911, in Johnson County, has a wing measuring 224.8, exposed culmen, 46.0, the width of the bill at the widest part, 24.6, and the height of bill at base, 22.1. A specimen listed by Gabrielson (1918) as *M. marila* proves upon subsequent examination to be a large Lesser Scaup with

the characteristic smaller bill-nail and purple reflections to the feathers on the sides of the head.

The fallacy of attempting a determination between this species and the Lesser Scaup in the field, based upon size and color markings, has been pointed out by numerous authors and need not be here elaborated. In view of the difficulty in identifying this species there may be some doubt in regard to records of its former breeding in the state.

Nyroca affinis (Eyton). Lesser Scaup Duck

An abundant migrant along the Mississippi River, and a common migrant through the valleys of the Cedar, Des Moines, and Missouri Rivers. There are numerous reports of this species in Iowa during the summer. It was recorded as formerly breeding in Cerro Gordo County by Cooke (1888) and in Hancock County by John Krider (1879). Proof of this bird breeding in Lee County, Iowa and Clark County, Missouri, as reported by W. E. Praeger and Edmonde S. Currier, is considered as only circumstantial by Anderson (1907) and Widmann (1907). Spurrell (1917) says that this species formerly bred in Sac County. A recent report from Allert stated that Charles Brooks had found this species with downy young in Clayton County. Roberts (1932) gives recent nesting records for Jackson, Pipestone, and Lincoln counties, Minnesota.

Glaucionetta clangula americana (Bonaparte). American Golden-eye

A fairly common migrant and winter resident on the Mississippi River, an uncommon migrant through the Missouri River Valley, and uncommon or rare through the interior of the state. Widmann (1907) gives an account of this species on the Mississippi River at Keokuk: "Mr. E. S. Currier had the opportunity to observe it every winter for eleven years and found it in flocks of from 30 to 100, sometimes much more numerous, as on January 17, 1903, and March 5, 1895, when a thousand were present." There are a number of Iowa specimens.

Charitonetta albeola (Linnaeus). Buffle-head

An uncommon migrant along the Mississippi and Missouri River valleys, fairly rare through the interior of the state. It was reported by Cooke (1888) as formerly breeding at Clear Lake, Cerro Gordo County. There are no recent breeding records.

This species is represented in collections by a number of Iowa specimens.

Clangula hyemalis (Linnaeus). Old-squaw

An uncommon and irregular visitor during the late fall or early spring. Anderson (1907) listed the observation by Thomas Say at Engineer Cantonment during the winter of 1819-20. Three males taken by Paul Bartsch in Des Moines County are now in the University of Iowa Museum: No. 10176, November 29, 1892; Nos. 16063 and 14157, November 22, 1895. Other records are enumerated from Jackson, Lee, Pottawattamie, and Woodbury counties, the latter a report of a bird shot at Rodney, Iowa, January, 1904 (Rich). The collection at Coe College contains two specimens secured by B. H. Bailey at Burlington, Des Moines County, on November 22, 1895. One in the collection at Iowa State Teachers College, Cedar Falls, was taken by H. Fields, March 13, 1901, in Blackhawk County. There is one in the Jefferson County Library taken by J. M. Shaffer in Jefferson County. A specimen in the Rosene collection at Ogden was secured by him in Boone County. One in the Smith collection, now in the Odebolt High School, was collected in Sac County. Harry Tennant of Arnold's Park, has two specimens which were taken near Ruthven, Palo Alto County, in the fall of 1920. These specimens were recorded by T. C. Stephens (1930) who reported another killed by Charlie Wilson, on Lake Okoboji, Dickinson County, during November, 1918. This specimen was mounted for the State Game Warden's museum at Spirit Lake. In a recent summary (Nebraska Bird Review, I, pp. 11-12) of the Old-squaw as a Nebraska bird, Myron H. Swenk called attention to the record by Thomas Say and listed several additional records for the region of Omaha. L. Bruner found a specimen shot on a lake near Blair, in Washington County, for sale in the Omaha market in the early 1890's. J. E. Wallace recorded two specimens shot on Carter Lake ("Cut-off Lake") near Omaha, December 8, 1900, by a local hunter, who brought the heads to him to identify. C. E. Mitchell identified one on Carter Lake, near Omaha, April 19, 1928. A Mr. Rose shot a male near Omaha on November 2, 1931. Another specimen, a female, was shot on the Missouri River five miles east of Tekamah, Burt County, on November 21, 1931, by a Mr. Falk of Omaha. On October 18, 1932, W. Wood of Council Bluffs, Iowa, shot a male which was mounted by Karl Schwarz.

Histrionicus histrionicus pacificus Brooks. Western Harlequin Duck

Accidental. Anderson (1907) included this species as a straggler, and listed two definite records for Nebraska by I. S. Trostler who took two specimens on the Missouri River at Omaha, September 16, 1893, and another at Florence Lake, near Omaha, September 19, 1895. These county records were given by Anderson as follows: "Pottawattamie—"Two Harlequin Ducks were brought to me for identification. They were killed at Big Lake, Pottawattamie County, Sept. 26, 1895" (Trostler). . . . Van Buren—"About eleven years ago a hunter shot three at one shot. This is the only time I ever knew of them being in our locality—Hillsboro" (W. G. Savage)." A male Western Harlequin Duck in breeding plumage was shot on the Des Moines River in Polk County, by James R. Harlan, December 27, 1932. The specimen is in the State Historical Museum, Des Moines.

Somateria mollissima dresseri Sharpe. American Eider

Accidental. Anderson (1907) states: "The American Eider is only an accidental visitor in Iowa. . . . Dr. G. C. Rich writes: 'Rare transient. I have a mounted specimen, shot in Woodbury County, Nov. 1, 1901'." This specimen, now in the collection of the Sioux City Academy of Science, was recently examined by the writer. Although the bird is in low plumage, the bill processes are diagnostic of this species.

Somateria spectabilis (Linnaeus). King Eider

Accidental. Anderson (1907) says: "Wm. E. Praeger, Keokuk, Iowa: 'On the 18th of November, 1894, a boy brought me a *Somateria spectabilis* that he had shot on the Mississippi. It was a male in brown plumage, but showing a few black and white feathers. The stomach contained nothing but fine quartz gravel' (Iowa Orn., i, 2, 1895, 52. Reprinted from the Auk)." The specimen, referred to above, is No. 25003, in the collection of the University of Iowa Museum. However, the date on the label, in Praeger's hand-writing, reads, Nov. 10, 1894, and is so recorded in the Auk, XII, p. 86.

Melanitta deglandi (Bonaparte). White-winged Scoter

An uncommon migrant along the Mississippi and Missouri River valleys, rare through the interior of the state. Anderson (1907) had reports of this species from Blackhawk, Linn, Des Moines, Lee, Palo Alto, Clay, and Woodbury counties. Allert reported this species as an uncommon migrant at McGregor. Harlan reported this bird as

a fairly common migrant in Polk County stating that only females had been observed. A female was collected by him on the Des Moines River during November, 1931. Stephens (1920) recorded the taking of an immature male at Brown's Lake, Woodbury County, on December 3, 1918, by a local hunter. It was mounted by A. J. Anderson of Sioux City. Youngworth (1931) listed four Woodbury County specimens, one taken November 7, 1927, one October 25, 1928, and two on October 19, 1929. The collection at Coe College contains a male, taken by B. H. Bailey at Cedar Rapids, Linn County, October 31, 1910. O. M. Greenwood reported (Iowa Bird Life, I, p. 11) that several White-winged Scoters were brought to him for identification by hunters in Delaware County during the second week in October, 1930. A pair was mounted and is now in his collection. On October 10, 1932, two females were received by the University of Iowa Museum. They had been killed by Carl Kurtz, in Johnson County, from a flock of five birds of the same kind. There are two Dickinson County specimens in the collection of Harry Tennant of Arnold's Park.

Melanitta perspicillata (Linnaeus). Surf Scoter

A rare late fall straggler. Anderson (1907) lists the following county records: "Des Moines—two specimens in University museum, collected at Burlington by Paul Bartsch; No. 16077, male juv., March 28, 1893; No. 16709, Nov. 22, 1895. Lee—'one specimen Oct. 20, 1895, and one Oct. 22, 1896, are my only records—Keokuk district' (Praeger). . . . Pottawattamie—'Iowa side of Cut-off Lake (No-man's-Land); straggler' (Trostler)."

W. E. Praeger (Auk, XLII, p. 576) says of the two Keokuk records mentioned above: "I have two records. Both of the birds turned up in the grocery stores and were probably from the rapids; the dates are October 20, 1895 and October 22, 1896."

Of the three Burlington specimens listed by Anderson only No. 16709 now remains in the University of Iowa Museum collection. There is, in addition, a juvenal female collected during November, 1930, by Herbert Dill at Amana, Iowa County. A female, collected at Cedar Falls, Blackhawk County, is in the Museum of the Iowa State Teachers College, Cedar Falls. There is a fully plumaged male, killed during 1929 at Spirit Lake, Dickinson County, in the collection of Harry Tennant of Arnold's Park. Wolden reported a specimen in the possession of his brother, taken at Estherville, Emmet

County, April 27, 1916. A female in the collection of O. W. Remer, Le Mars, was killed at Blue Lake, Monona County, November 16, 1919 and recorded by Stephens (1920). Youngworth (1931) recorded one taken in November, 1925, in Woodbury County which was sent to H. S. Linn for mounting.

Oidemia americana Swainson. American Scoter

Very rare. Anderson (1907) gives these county records: "Black-hawk—a casual specimen taken some years ago" (Peck). Jackson—"rare transient" (Giddings). Lee—"one specimen taken Oct. 31, 1891—the only record" (Praeger); "rare visitor" (Currier). . . . Pottawattamie—"straggler; Cut-off Lake, Iowa (No-man's Land); several killed by Omaha sportsmen and mounted by taxidermists" (Trostler)." Widmann (1907) cites the record of Praeger, but records the date as October 31, 1895. In his article "Birds of the Des Moines Rapids" (Auk, XLII, p. 575) Praeger says: "One purchased on the market, on October 31, 1894; the only record."

Myron E. Swenk records (Letter of Information, No. 20, 1927) a flock of 3 American Scoters swimming in the Missouri River near Camp Gifford, a few miles southeast of Omaha, January 16, 1927. They were studied under favorable conditions for nearly half an hour by C. A. Mitchell, Mr. and Mrs. L. O. Horsky, Elizabeth Rooney, and Fred Eastman.

There are no Iowa specimens preserved.

Erismatura jamaicensis rubida (Wilson). Ruddy Duck

An uncommon and irregular migrant along the Mississippi River Valley; reported by Bennett (1931) as a common migrant in the Sioux City region; an uncommon or rare migrant through the interior of the state. This species was unreported by several observers. H. M. Sanderson of Des Moines reported this species as common more in 1932 than in 1930 and '31.

The Ruddy Duck was reported as breeding in Hancock County in 1903. A specimen in the Philadelphia Academy of Natural Sciences was taken by W. L. Abbott in Dickinson County during July, 1881. Leopold (Outdoor America, 1932-33) has reported this species as breeding in Palo Alto and Allamakee counties since 1920. Logan J. Bennett reports a nest found on Mud Lake, Clay County, May 25, 1933. The writer has recently observed this species as a migrant

during the last of May or the first two weeks of June in Hamilton, Dallas, and Polk counties.

Lophodytes cucullatus (Linnaeus). Hooded Merganser

A fairly common migrant in the eastern half of the state, less numerous along the Missouri River Valley. This species formerly was more numerous as a migrant and local breeder. Some observers at the present time report it as a rare migrant. Harlan reported the Hooded Merganser as a fairly common migrant in late October and early November, 1930. At least a hundred birds were seen by him while descending the Des Moines River from Boone to Des Moines. The writer knows of no authentic breeding records during the past two decades, although there were several observations of this species in May and June (DuMont: Wilson Bull., XLIV, p. 171).

Mergus merganser americanus Cassin. American Merganser

A fairly common migrant; occasionally wintering. Reported by a few observers through the interior of the state as rare. Cooke (1888) stated that it had been found breeding in northern Iowa by Mr. Preston of Newton, Iowa. Roberts (1932) says of this species in Minnesota: "There are no recent breeding records for the southern part of the state, though there is reason to believe that it once nested in limited numbers as far south as the Iowa line (Heron Lake, Jackson Co., Preston in Ornith. and Oöl., 12: 44, 1887 . . .)."

There are no recent breeding records in Iowa.

Mergus serrator Linnaeus. Red-breasted Merganser

An uncommon and irregular spring and fall migrant. There are no wintering records for Iowa, although individuals may be seen in late February or March. This species is not known to have bred in Iowa. There are a number of specimens.

Order FALCONIFORMES

Family Cathartidae

Cathartes aura septentrionalis Wied. Turkey Vulture⁷

A fairly common summer resident, most numerous in the southern half of the state. Judging from the numbers seen by J. A. Allen (1868) this bird must have been abundant in earlier days when the larger wild animals were here in numbers. Bailey (1918) recorded

⁷The University of Iowa Museum recently received an adult male Black Vulture, *Coragyps a. atratus* (Meyer), which was shot September 17, 1933 by Louis S. Trevarthen along the Raccoon River near Perry, Dallas County. This constitutes the first Iowa record.

this species as breeding in the state as far north as Howard, Blackhawk, Dickinson, and Woodbury counties.

Family Accipitriidae

Elanoides forficatus forficatus (Linnaeus). Swallow-tailed Kite

Very rare. This beautiful bird was formerly a fairly common summer resident throughout the state, but by 1880, apparently, it was considerably reduced in numbers and was thereafter observed most frequently as a migrant. The last migratory flight of any size is mentioned by W. W. Searles, of Lime Springs, Howard County (Iowa Ornithologist, I, 1895, p. 90) who found them abundant for three days during May, 1888.

Records of this bird in Iowa since 1900 are indeed few. An adult specimen taken during the fall of 1901 by D. J. Bullock in Jasper County, is now in the Bullock collection, Des Moines. An immature male was collected at Cedar Rapids, Linn County, September 20, 1903. It is now in the Coe College collection. Another taken in Sheridan Township, Poweshiek County, September, 1907, is in the collection at Grinnell College. The collector is unknown. Spurrell (1917) says: "Mr. Lee reported the swallow-tailed kite as rare, with the last one seen in 1908." Nauman records (Palimpsest, V, p. 137) seeing one flying over the town of Sigourney during the summer of 1910. Bailey (1918) states: "The last recorded observation of this bird in Iowa was made by J. H. Scott, of Iowa City, on Wapsipinicon River near Independence in August, 1912." One of the two specimens of Swallow-tailed Kite in the Shaffer collection, Jefferson County Library, Fairfield, was killed by B. F. McElhinny in 1913, in Jefferson County. Fenton (1923-24) records one seen by C. H. Belanski and himself at Hackberry Grove, Cerro Gordo County, May 28, 1916. Myron H. Swenk records (Wilson Bull., XLIV, p. 182) a specimen killed by a farmer early in July, 1931 along the West Nishnabotna River, a few miles southwest of Oakland, Pottawattamie County, Iowa. The specimen was mounted by Karl Schwarz of Omaha, and is now in Swenk's collection, Lincoln, Nebraska.

Besides the five Iowa specimens mentioned above there are several others taken prior to 1900. One in the U. S. National Museum, Washington, D. C., was taken at Sioux City by D. H. Talbot. Another Talbot specimen was collected by J. F. Baker at Sioux City, Woodbury County, April 8, 1883. It is a male, and is in the col-

lection of the University of Iowa Museum. A mounted specimen, taken by J. B. Atkins in Jasper County, is in the Parker Museum at Grinnell College. Three specimens from Scott County, without dates, are in the collection of the Davenport Public Museum. Two of the specimens were taken by S. C. Bowman and the other by W. L. Allen. A second specimen in the Shaffer collection, Fairfield, was probably taken in Fairfield County by J. M. Shaffer, sometime before 1900. Fenton (1923-24) states that there is a specimen in the Miles collection, Charles City, which was probably taken in Floyd County. Spurrell (1917) records that one in the H. B. Smith collection, Odebolt, was taken in Ida County.

Bailey (1918) recorded this species as a former breeder in Woodbury, Crawford, Carroll, Greene, Decatur, Blackhawk, and Benton counties.

Ictinia mississippiensis (Wilson). Mississippi Kite

Formerly a casual visitor. Anderson (1907) lists the following county records: "Blackhawk—'only one observed here. I remained over half an hour within twenty feet of the bird when it was resting on a post in hedge, so that identification is positive' (Salisbury). . . . Van Buren—'a kite of this species occurred one spring on Big Cedar at a certain place and stayed four or five weeks, then disappeared. I saw the bird many times and once while fishing it came and sat within twenty yards of me, so I positively identified it. The stream running about east and west, it ranged in Van Buren and Henry counties, four and one-half miles north and a little east of Hillsboro' (W. G. Savage). Webster—'a specimen was seen around Duncombe's Stucco Mill (Ft. Dodge) nearly every day, and I finally shot him a mile further down the stream (Des Moines River); length 14.5 inches; dark bluish, grayish to slate color; tail nearly black' (Somes). Woodbury—'according to D. H. Talbot, formerly visited this county' (Rich)." Bailey (1918) states: "Two specimens of the Mississippi Kite were secured in the fall of 1887 near Burlington. They were mounted by Mr. Chas. Buettner, of that city and were examined by the writer in the museum of the Iowa Wesleyan College at Mount Pleasant." These two specimens remain in the collection at Iowa Wesleyan College, and were seen recently by the writer. The date on the label of one specimen is August 26, 1884. The catalogue of the University of Iowa Museum contains the entry, "No. 17446, *Ictinia mississippiensis*, Sioux City, Iowa, 7-1-84, D. H.

Talbot." Probably this was the Talbot specimen cited by Bennett (1931). However, the specimen cannot now be found. There are no records since 1890.

Astur atricapillus atricapillus (Wilson). Eastern Goshawk

Normally a rare and irregular winter visitor. Occasionally, as during the winter of 1916-17, there have been pronounced invasions of this hawk into all parts of the state. At such times they do considerable damage to poultry and game birds. There are a number of specimens.

Bailey (1918) recorded the capture of two adult goshawks which he referred to *Astur a. striatulus* Ridgway. W. F. Kubichek and the writer recently examined these birds and concluded that the slightly darker cross-barring of the breast was due to an admixture of a juvenal plumage. Therefore, this Pacific Coast form has not been added to our state list.

Accipiter velox velox (Wilson). Sharp-shinned Hawk

A fairly common spring and fall migrant, and an uncommon summer resident; found occasionally in winter. The Sharp-shinned Hawk breeds sparingly in the northern two-thirds of the state. It has been reported as a rare permanent resident in Polk and Blackhawk counties, but these conclusions may have been based on an occasional wintering bird.

Accipiter cooperi (Bonaparte). Cooper's Hawk

A common migrant and a fairly common summer resident in all parts of the state. It is a fairly common breeding bird. This species is somewhat more frequently found as a wintering bird than is the Sharp-shinned Hawk.

Buteo borealis borealis (Gmelin). Eastern Red-tailed Hawk

A fairly common summer resident, most numerous in the eastern and southeastern portions of the state and less common in the northwest. Probably a number of individuals are permanent residents. The local population is considerably augmented during the spring and fall by migratory flights occasionally of some size.

The Eastern Red-tailed Hawk is a fairly common breeding bird, probably being replaced somewhat in the northwestern corner of the state by the paler and illy-defined subspecies, *Buteo b. krideri*. There

are typical examples of the Eastern Red-tailed Hawk taken during the breeding season in the Sioux City region.

Buteo borealis krideri Hoopes. Krider's Hawk

A fairly common migrant. This paler-colored Red-tail was reported by Anderson (1907) as an uncommon breeder in practically all parts of the state, apparently occupying an area contiguous with that of the eastern subspecies. Considerable study of these birds during the breeding season is needed to determine their distribution in the state. Undoubtedly it will be found breeding in greater numbers in the northwest than *B. b. borealis*.

In a series of thirty-three Iowa specimens of Krider's Hawk recently examined, all except one had been secured during the migratory period. There is an immature specimen of this hawk in the collection at Coe College which was taken at Cedar Rapids, Linn County, May 10, 1904. One in the Philadelphia Academy of Natural Sciences was taken by W. L. Abbott in Winnebago County, August 30, 1879.

Buteo borealis calurus Cassin. Western Red-tailed Hawk

A fairly rare migrant from the west. Nine Iowa specimens in the normal plumage have been examined by the writer. Two of these are in the University of Iowa Museum, No. 28688, adult female, taken November 7, 1922, by W. F. Coultas at Midriver, Johnson County; No. 18537, adult female, collected October 25, 1901, by R. M. Anderson, Iowa City, Johnson County. Another specimen is in the collection of Homer R. Dill of Iowa City. It is an adult male, taken November 7, 1923, by Carl Linder at Iowa City, Johnson County. Six specimens, all adults, are in the collection at Coe College. Three females and one male are from Linn County, a male is from LaPorte City, Blackhawk County, and one with no more definite locality than Iowa. The range of dates for these six specimens is from October 27 to December 6.

The characteristic dark phase of the Western Red-tail has been taken in various parts of the state. Rosene has one in his collection taken in Boone County. There is one mounted in the collection of the State Historical Museum, Des Moines, that was secured at Patterson, Madison County. A female in the Allert collection was taken October 12, 1927, at Giard, Clayton County.

Both Anderson (1907) and Bailey (1918) have recorded the Western Red-tail as a casual breeder in Iowa. A recent study of the Iowa Red-tailed Hawks (Iowa Bird Life, III, pp. 5-7) has convinced the writer that all published records of *Buteo b. calurus* and *B. b. harlani* breeding within the state were based upon misidentified specimens. No evidence of breeding has been found.

Buteo borealis harlani (Audubon). Harlan's Hawk

An uncommon migrant. There are a number of specimens taken during the migratory period. Anderson (1907) recorded specimens from Winnebago and Woodbury counties. The writer has recently recorded (Iowa Bird Life, III, pp. 5-7) specimens from Van Buren, Johnson, and Polk counties. Two others in the University of Iowa Museum are from Linn and Monona counties. The five specimens in the Coe College collection are from Marshall, Linn (three specimens), and Iowa counties. Stephens records (1918) a specimen taken by A. J. Anderson between Salix and Sergeant Bluff, Woodbury County, March 29, 1918. One in the Parker Museum, Grinnell College, was taken at Grinnell. There is a juvenal male in the collection of the Iowa State Historical Museum, Des Moines.

Two specimens in the Coe College Museum are extremely puzzling in that they combine the characteristics of at least two races of *Buteo borealis*. No. 778, an adult female, taken by J. Ward at Britt, Hancock County, October 17, 1917, is typical of *borealis* in all respects except the tail. The basal two-thirds of each bright rufous rectrix is finely mottled with black, the character most distinctive of *harlani*. The other, an adult, collected by Claude Boles at Springville, Linn County, December 8, 1928, may be considered typical of *calurus* in the dark phase with solid black underparts, uniformly dark back and rusty on hind neck. The bright rufous tail contains four rectrices with black mottling basally, two with ill-defined dark cross bars, and the remainder embodying a mixture of mottling and harring.

Anderson (1907) considered the Harlan's Hawk only a migrant in Iowa, while Bailey (1918) stated that it had been found breeding. No substantiating evidence was offered, only the map of distribution showing two breeding records in Benton County and three in Iowa County. In a series of over sixty Red-tailed Hawks in the University of Iowa Museum and in a series of sixty-seven others

in the Museum at Coe College (with the exception of one Krider's Hawk), there are no specimens other than *Buteo b. borealis* which had been collected in Iowa during the breeding season. The same thing may be said in regard to all the other collections of Iowa birds examined by the writer. It seems advisable to remove the Harlan's and Western Red-tailed Hawk from the list of Iowa breeding birds until substantiating specimens and eggs are secured.

Buteo lineatus lineatus (Gmelin). Northern Red-shouldered Hawk

A fairly common summer resident in the southern half of the state, uncommon or rare in the northern half; a few are permanent residents. This species was reported by Bailey (1918) from Winneshiek, Winnebago, and Kossuth counties in the north, and as breeding in Winneshiek and Floyd counties. Allert reported this bird as a summer resident along the Mississippi River in Clayton County. It is reported as rare by the following: Spiker, Chickasaw County; Pierce (1930), Buchanan County; Bennett (1931), Woodbury County; Rosene, Boone County; Gabrielson (1918), Marshall County.

Buteo platypterus platypterus (Vieillot). Broad-winged Hawk

An uncommon spring and fall migrant, occasionally appearing in great numbers. Reported as a common summer resident in Wapello County (Spiker, 1924), Polk County (DuMont, 1931), Floyd County (Fenton, 1923-24), and Chickasaw County (Spiker). Bailey (1918) reported this species as a breeder in Floyd, Winnebago, Kossuth, Poweshiek, and Pottawattamie counties. To these may be added Chickasaw, Polk, and Woodbury counties. The writer recorded (1931) that one pair of Broad-winged Hawks were permanent residents in Polk County during 1928 to 1930. Other observations of these birds at the same locality in Des Moines were reported for December, 1925 and December 26, 1932. Pierce recorded (1930) one found in Devil's Backbone State Park, Delaware County, on December 23, 1923.

In the collection at Coe College there is one of the two melanistic specimens upon which B. H. Bailey based his description (Auk, XXXIV, pp. 73-75) of the "Iowa Broad-winged Hawk" (*Buteo p. iowensis*). This specimen, from Johnson County, is now considered as merely a dark phase, such as occurs in the Swainson's and Rough-legged Hawks. The second specimen cited by Bailey is one taken by A. J. Anderson, twelve miles east of Des Moines, Polk County,

on October 30, 1893. The latter is now in the collection of the Pettigrew Museum, Sioux Falls, South Dakota.

Buteo swainsoni Bonaparte. Swainson's Hawk

An uncommon migrant; a summer resident of decidedly local distribution. Bailey (1918) recorded it as a breeding bird in Winnebago, Hancock, Benton, Poweshiek, Jasper, and Mills counties. Pierce (1930) recorded the Swainson's Hawk as a fairly common migrant and he stated that he had numerous summer records which indicated that it must nest in the region. This species was unreported from a number of localities in the state, and reported as rare in others.

The writer has found but three specimens of Swainson's Hawk that were taken in Iowa. A female, No. 15886, in the University of Iowa Museum was taken by one of Talbot's collectors at Sioux City, Woodbury County, September 4, during the 1880's. One in the collection of the Iowa State Teachers College was taken at Cedar Falls, during September, 1907. A specimen in the collection at Coe College was secured at Cedar Rapids, during May, 1932.

Buteo lagopus s. johannis (Gmelin). American Rough-legged Hawk

Fairly common winter visitor in the northern part of the state, somewhat less numerous in the southern half. There are numerous specimens of this bird, in both the light and dark phases, with the latter predominating.

Buteo regalis (Gray). Ferruginous Rough-leg

An irregular and decidedly uncommon migrant in the western part of the state, rarely straggling into the eastern portion. Bailey (1918) recorded it as occurring in Blackhawk, Linn, Woodbury, Pottawattamie, and Mills counties. No doubt this record was based upon the county records as published by Anderson (1907). The observation of this bird in winter, as reported by Berry in Linn County, may well be discredited, lacking substantiating evidence.

Bennett (1931) recorded it as an uncommon migrant in the Sioux City region. DuMont (1931) recorded that a pair of these birds was observed by Mr. and Mrs. J. E. Stewart at Brenton's Slough, Polk County, May 5, 1929. On June 6, 1929, a pair was seen at the same place by A. T. Watson, K. R. Nelson, and the writer. Nauman reported one seen near Sigourney, Keokuk County, April 2, 1919, and two in the same locality, March 28, 1923. Spiker (1924) recorded one found hanging on a fence, November 4, 1914 in Wapello

County. Pierce (1930) observed a single bird on his farm in Buchanan County, March 17 and 19, 1926. Another was seen near Hazelton, in the same county, April 13, 1930.

A female, taken at Cedar Falls, Blackhawk County, June 25, 1901, is in the collection of Iowa State Teachers College, Cedar Falls. Stephens records (1918) that A. J. Anderson of Sioux City mounted one of these birds September 17, 1917 which had been shot at Brown's Lake, Woodbury County. Two other specimens mounted by Anderson were recorded by Stephens (1930). One was a female, taken near Sioux City, October 3, 1921, a very dark specimen; the other, also a female, reported to have been taken near Kingsley, Plymouth County, November 23, 1921.

Parabuteo unicinctus harrisi (Audubon). Harris's Hawk

Of accidental occurrence in Iowa. Anderson (1907) says of this species: "Its admission to the Iowa list is based upon a single specimen captured in Van Buren County, near Hillsboro. Walter G. Savage writes concerning it, February 25, 1904: 'Nine years ago a trapper caught one in a steel trap and brought it to me. This is the only one that I can positively identify in our locality. My father took this hawk and now has a fine painting from it, true to nature. It is identical with your description, and also Coues'. It is surely a Harris Hawk'."

Aquila chrysaetos canadensis (Linnaeus). Golden Eagle

An irregular straggler from the west. Individuals have been captured in all parts of the state, most frequently during the early spring and late fall months. There are specimens or authentic reports of this species from thirty-three of the ninety-nine counties in Iowa.

Haliaeetus leucocephalus alascanus Townsend. Northern Bald Eagle

An immature female of this larger northern race was secured March 11, 1896, at Salem, Henry County, Iowa. It is No. 16140 in the collection of the University of Iowa Museum, and was deposited by Paul Bartsch. Measurements in millimeters of the specimen recently taken by the writer are: wing, 682.0; tail, 369.6; tarsus, 105.2; exposed culmen, 69.1; culmen without cere, 56.0; depth of culmen at base, 39.4. This subspecies has not previously been reported from Iowa.

Haliaeetus leucocephalus leucocephalus (Linnaeus).

Southern Bald Eagle

An uncommon migrant along the larger rivers of the state, less numerous through the interior; occasionally found in winter. Formerly the Bald Eagle was found in greater numbers, and some few nested in favorable localities from the central part of the state north. There are no breeding records since 1892.

Measurements of several Iowa specimens in the collection of the University of Iowa Museum indicate that these birds are more or less intermediate in size between *leucocephalus* and *alascanus* and average nearer the latter form. Only No. 28882 appears to be typical of *leucocephalus*.

No.	Sex	Locality	Date	Wing	Tail	Tarsus	Culmen without Cere	Depth
5407	female	Whiting	1885	662.9	360.7	99.3	52.2	35.6
28597	female	Dubuque	Nov. --, 1931	660.4	368.3	85.8	57.0	36.5
16138	female	Burlington	Oct. 10, 1891	596.9	304.8	96.8	51.6	35.6
16136	male	Burlington	Dec. 20, 1894	647.7	292.1	87.6	58.1	37.8
28795	juv.	Johnson Co.	Oct. 26, 1928	635.0	311.1	91.4	54.2	35.8
15474	adult	Johnson Co.	1897	609.6	294.6	84.0	51.4	38.1
16137	male	Burlington	Sept. 22, 1895	558.8	-----	88.4	----	34.5
28882	male	Marshalltown	May 13, 1913	548.0	247.0*	61.0	47.3	34.8

Circus hudsonius (Linnaeus). Marsh Hawk

A common migrant and fairly common summer resident; found rather frequently in winter, especially in the southern part of the state. It is most numerous as a breeding bird in the northern part of Iowa.

Pandion haliaëtus carolinensis (Gmelin). Osprey

An uncommon migrant along the larger rivers of the state, somewhat rare or irregular through the interior. Bailey (1918) recorded that George H. Berry collected a single addled egg from a nest in which were three young, May 16, 1892, five miles above Cedar Rapids, near the Cedar River, Linn County. This is the only breeding record.

Family Falconidae

Falco mexicanus Schlegel. Prairie Falcon

A rare straggler in Iowa. Anderson (1907) recorded accounts of

*Tail worn.

the taking of specimens in the following counties: "Blackhawk—"one specimen taken in Blackhawk County many years ago by George D. Peck' (M. E. Peck). Buena Vista—"Storm Lake, Iowa, Frank Bond. Specimen in University Museum"—No. 3576, male (C. C. Nutting, Proc. Iowa Acad. Science, 1892, 41). Mills-Pottawattamie—"rare migrant. Though I have seen this species a number of times in Pottawattamie and Mills counties, the only notation of date I have is July 4, 1892, one killed at Honey Creek Lake while trying to catch young Mallard ducks. I have seen it in Mills County during the last five years, in the spring time (April), but have no exact notations' (Trostler). Sioux—"shot male at Hawarden, in 1890' (Berry)." There is no record of what became of Berry's specimen. Morton E. Peck, now of Salem, Oregon, wrote October 12, 1932, saying: "My father, George D. Peck, collected a specimen of Prairie Falcon in Blackhawk County, more than fifty years ago. It was identified and purchased by someone in the East, but I do not know by whom." The Bond specimen cannot be found.

Harry Tennant has two specimens of the Prairie Falcon in his collection at Arnold's Park. Both birds were taken at Lake Okoboji, one during "duck shooting time" about 1927, the other in the fall of 1925. An adult, probably a female, was secured in Story County during the fall of 1927, by D. J. Bullock. It is mounted and is in the Bullock collection at Des Moines.

Falco peregrinus anatum Bonaparte. Duck Hawk

A rare migrant. The recently recorded occurrences of this bird are, indeed, few in number. Three reports during the past decade are from Woodbury, Boone, and Polk counties. This hardly may be considered as a true index of its numbers, as the Duck Hawk has been reported by Roberts (1932) as nesting in the Lake Superior region and along the bluffs of the Mississippi and St. Croix rivers. During the migration periods some of these birds must pass across Iowa.

The Duck Hawk was a former breeder in various parts of Iowa. The last authentic nesting record was published by B. H. Bailey (Proc. Iowa Acad. Sci., X, pp. 93-98). He reported that it nested every year until 1898 along the "Palisades" of the Cedar River, Linn County.

Falco columbarius columbarius Linnaeus. Eastern Pigeon Hawk

An uncommon migrant, very rarely remaining until December and

January. Bailey (1918) enumerated but two records of the Pigeon Hawk nesting in Iowa, one found near Grinnell by Lynds Jones, probably in the '80's, and the other found April 27, 1908 by George H. Berry in Linn County. On the basis of Iowa specimens recently examined, the Eastern and Western Pigeon Hawks may be considered equally numerous as migrants through Iowa. Two typical examples of *Falco c. columbarius* are contained in the collection of Coe College. Both are males, taken in Linn County, one on September 18, 1903, the other October 12, 1930. Two in the University of Iowa Museum were taken by Paul Bartsch at Burlington, Des Moines County. No. 16437, an adult female, was secured during October, 1895. No. 16241, an adult male, was taken October 4, 1895.

Falco columbarius richardsoni Ridgway. Richardson's Pigeon Hawk

A rare straggler. Anderson (1907) listed an accidental specimen taken by George H. Peck at LaPorte, Blackhawk County. C. C. Nutting reported that a specimen taken by Frank Bond at Storm Lake, Buena Vista County, was in the University of Iowa Museum. Morton E. Peck wrote that the specimen taken by his father, George D. Peck, in Blackhawk County, had been disposed of many years ago, to someone in the East. The writer has been unable to find the Bond specimen mentioned above. The collection of the University of Iowa Museum contains an immature female taken December 18, 1894 at Forest City, Winnebago County, by Rudolph M. Anderson. This specimen is typical of *Falco c. richardsoni*, with the sandy colored plumage and the tail crossed by six light and five dark bands. It is somewhat larger than the Eastern Pigeon Hawk with a wing of 221.0 millimeters and a tail of 131.3 millimeters.

Falco columbarius bendirei Swann. Western Pigeon Hawk

Probably an uncommon migrant. Three specimens of this paler western variety, recently identified by H. C. Oberholser, are contained in the collection of the University of Iowa Museum. These are: No. 28084, female, taken at Emmetsburg, Palo Alto County, September 5, 1921, by David Scott; No. 16242, male, collected by Paul Bartsch at Cedar Rapids, Linn County, April 25, 1893; No. 16438, female, taken at Cedar Rapids, during the spring of 1892, by Paul Bartsch. With a further examination of Iowa specimens, *bendirei* will probably be found equally numerous with *columbarius* as a migrant. This subspecies has not previously been reported from Iowa.

Falco sparverius sparverius Linnaeus. Eastern Sparrow Hawk

A common migrant, and a fairly common summer resident, breeding throughout the state; occasionally found in winter.

Order GALLIFORMES

Family Tetraonidae

Bonasa umbellus umbellus (Linnaeus). Eastern Ruffed Grouse

Rare or absent in most parts of the state. Most numerous in Allamakee County, and a few remaining in Howard, Butler, Hardin, Guthrie, Van Buren, Iowa, Buchanan (1923), Delaware (1923), Jackson, and Clayton counties. Allert reports this species as tolerably common in Clayton County.

The Ruffed Grouse was formerly a common resident in all parts of the state with the possible exception of the northwest corner. Leopold (Outdoor America, 1932-33) has pointed out that this species has disappeared from 11 counties since 1900, and that over most of the state it is nearer extermination than the prairie chicken, and furthermore does not have the advantage of replenishment by migration.

There are numerous Iowa specimens all of which refer to this form, the Canada Ruffed Grouse (*Bonasa u. togata*) not being found this far south.

Tympanuchus cupido americanus (Reichenbach).

Greater Prairie Chicken

Greatly reduced in numbers but remnants of breeding flocks are yet found in Fayette, Winneshiek, Howard, Mitchell, Cerro Gordo, Franklin, Marshall, Wright, Hancock, Kossuth, Palo Alto, Dickinson, Clay, Sac, Crawford, Monona, Woodbury, Plymouth, and Lyon counties (Leopold: Outdoor America, 1932-33). The largest of the remaining breeding flocks in the southern part of the state are in Wayne County. During the winter months the resident chicken population is increased greatly by the influx of migrants from Minnesota and the Dakotas. These flocks are noted more or less regularly through the central and western parts of the state, south, occasionally, to the Iowa-Missouri line.

Leopold has stated that since the hunting season was permanently closed on the Prairie Chicken in 1916, it has disappeared as a breeding bird from 11 counties. Therefore the preservation of this bird

in Iowa is not dependent only upon a cessation of legal shooting but unquestionably requires provision of adequate nesting cover.

There are fifteen mounted specimens in the Shaffer collection, Jefferson County Library, Fairfield, and numerous specimens in most of the other collections.

Pedioecetes phasianellus campestris Ridgway.

Prairie Sharp-tailed Grouse

A rare winter migrant in the northwest corner of the state. Recorded since 1895 as a migrant in Polk, Tama, Bremer, Butler, Franklin (in 1931), Webster, Kossuth, and O'Brien counties. A wintering flock of 200 was observed repeatedly during 1927 in O'Brien County by William Schuenke.

A specimen secured by W. E. Moore at Des Moines, Polk County, about 1850, is in the collection of the American Museum of Natural History, New York City. One taken in Sac County is in the Smith collection, Odebolt High School.

Family **Perdidae**

Perdix perdix perdix (Linnaeus). European Partridge

An introduced species which has become a fairly common resident in the northwestern part of the state, is apparently limited in distribution to that area which was formerly covered by the Wisconsin glaciation. Leopold (Outdoor America, 1932-33) gives a full history of this species in Iowa and the following items are taken from his report. The first plantings of this species in Iowa were made in northwest Blackhawk County by Senator H. W. Grant of Waterloo, in 1902, but these disappeared during the hard winter of 1902-3. In 1905, small plantings were made in Palo Alto and Carroll counties. The Carroll County planting disappeared. The Palo Alto planting, made by a Mr. Carter, survived and spread, and constitutes Iowa's first wild stock. During the period of 1906-10 plantings were made in six counties. About 1914 all the northeastern counties were systematically covered by standardized plantings of 20 pairs each. At present this European or Hungarian Partridge is found in the northern part of the state and the southern border of its range is through the following counties: Worth, Cerro Gordo, Hancock, Wright, Humboldt, Pocahontas, Buena Vista, Cherokee, Ida, Woodbury, Plymouth, Sioux, and Lyon. There are reports of straggling

birds in Webster, Carroll, and Monona counties. An effort will be made to establish this species in the southwestern part of the state by means of systematic planting in a test area.

Colinus virginianus virginianus (Linnaeus). Eastern Bob-white

A resident throughout the state, most numerous in the southern half, not common in the northwest and north-central portions, common in only a few places in the northeast corner. This species was formerly abundant, but overshooting, together with severe winters, and a shortage of cover due to intensive farming, have been responsible for reducing their numbers. Since 1916 the Bob-white has been protected by a permanent closed season. Even this benefit has not enabled it to increase to its former numbers. Undoubtedly the introduction of the Pheasant and European Partridge has had some effect on the natural increase of the quail in the northwest.

Family **Phasianidae**

Phasianus colchicus torquatus Gmelin. Ring-necked Pheasant

This introduced species is a common resident in the northern part of the state. "The present Iowa Pheasant boundary is identical with the glacial boundary from Winneshiek County southeast to Delaware. Then comes a gap where there is no clear pheasant line, but in Tama it again becomes clear and parallels the glacial line westward across the central counties to Carroll. Here the pheasant line departs sharply southwest to the Missouri River." (Leopold, Outdoor America, 1932-33). Projected plantings may alter this range considerably.

Family **Meleagrididae**

Meleagris gallopavo silvestris Vieillot. Eastern Turkey

Extinct since 1910 in Iowa. Leopold (Outdoor America, 1932-33) has summarized the former status of this species and these notes are taken from his report. It was last found in Clayton County, northeastern Iowa, about 1853 or '54. They were reported as plentiful in Cherokee County, northwestern Iowa, in 1860 and one was killed in that county by George Rosch of Marcus, in April, 1897. Turkeys were reported as very common in Ida County during the decade 1860 to 1870. In southern Iowa there are numerous reports until about 1900. The last individuals were noted in Appanoose County in 1902, Davis County in 1905, and three in Lucas County, 1910.

Pierce (1930) recorded an account of their former abundance in Buchanan, with flocks of as many as a hundred. Spurrell (1917) stated that three were killed at Grant City, Sac County, in 1854. Evidently the turkey was formerly found in all of the wooded areas of the state, ranging as far north as Clayton County along the Mississippi River, and in the northwest to Woodbury and Cherokee counties. Fenton (1923-24) recorded a note relative to the capture of a turkey south of Charles City, in 1898. Certainly there may be some question as to the probability of one being taken at such a late date in the north-central part of the state. The specimen was lacking.

Two existing specimens are known to have been taken in the state. A juvenal female, taken during November, 1886 by W. O. Crosby, is mounted in the University of Iowa Museum. No more specific locality than Iowa is recorded. A male gobbler, probably killed by J. M. Shaffer, in Jefferson County, is in the collection of birds in the Jefferson County Library, Fairfield.

Introduced stock has been recently planted in several areas in the state.

Order GRUIFORMES

Family Gruidae

Grus americana (Linnaeus). Whooping Crane

Extinct in Iowa. Anderson (1907) regarded this species as only a rare migrant in Iowa by 1900 stating, however, that it was formerly a well-known and fairly common summer resident in the state, breeding in the large marshes which were at that time characteristic of northern Iowa.

Numerous accounts relative to the breeding of the Whooping Crane in northern Iowa are contained in the writings of the early naturalists. The last pair known to have bred in the state was found by R. M. Anderson in Hancock County, May 26, 1894 (Oölogist, IX, 8, 1894).

The writer has been able to find but few records of this crane in Iowa since 1900. Spurrell (1917) stated that his last record of this species in Sac County was March 24, 1904. Gabrielson (1917) recorded that on April 9, 1911, he saw five birds near Webb, Clay County, which were undoubtedly this species. They were standing near the edge of a small pond and he was able to approach within 300 yards and examine them through glasses.

As in the case of all the extinct or nearly extinct species in Iowa,

so few specimens were preserved that it seems advisable to enumerate all of them. A number are to be found lacking any data, but the following are believed to be authentic records. One in the collection at Coe College, No. 492, was taken at Cedar Rapids, Linn County, by a Mr. Sinclair in 1880. Three specimens, one a downy young, were taken in Winnebago County, and are now in the Philadelphia Academy of Natural Sciences. There are three Whooping Cranes in the Shaffer collection at Fairfield. J. Wilbur Dole wrote that one was presented to the museum by Mrs. Mary McElhinny. The other two were contained in the Shaffer collection and were probably taken in Jefferson County. The dates on the specimens are 1870, 1873, and 1880. A specimen, now in the possession of Frank F. Ellis of Maquoketa was for many years in the school museum at Bellevue, and is believed to have been taken in Jackson County. Seven Iowa specimens were secured by D. H. Talbot and his collectors. Of these four specimens, all from Holly Springs, Woodbury County, remain in the collection of the University of Iowa Museum. They are: No. 5395, female, April, 1887; No. 5399, female, April 8, 1887; No. 5400, sex not recorded, April 8, 1887; No. 5403, sex not recorded, 1887. The data of the other three, as taken from the catalogue, are: No. 5392, male, Humboldt, Humboldt County; No. 5397, female, Holly Springs, April 8, 1887; No. 5398, male, Wolf Creek Slough, Woodbury County, April 13, 1884.

Grus canadensis canadensis (Linnaeus). Little Brown Crane

The status of this species at the present time is undetermined. Due to the fact that the plumage is exactly the same as in the Sandhill Crane, the difference between the two being a matter of size, it is out of the question to distinguish between them in the field. The notion has been rather prevalent that as a migrant the Sandhill Crane was by far the more numerous of the two through the Mississippi and Missouri River valleys. Therefore all field observations are generally recorded as of the larger form, *Grus c. tabida*.

A recent study (Wilson Bull., XLV, pp. 13-15) by the writer, of twenty-eight specimens of *Grus canadensis* from Iowa and Nebraska, contained in the collection of the University of Iowa Museum, showed that twenty-two of these birds are referable to *canadensis* and the other six to *tabida*. All the specimens were secured by D. H. Talbot and his collectors between 1884 and '87. The fourteen Iowa specimens of the Little Brown Crane are from Holly Springs and Sloan,

Woodbury County, and Whiting, Monona County. There are no recent reports or additional specimens known to the writer. The Little Brown Crane is not known to breed in Iowa, its breeding grounds being in northern Canada and Alaska.

Grus canadensis tabida (Peters). Sandhill Crane

A rare migrant at the present time. In 1907 Anderson stated: "It formerly nested quite commonly in the marshes of northern Iowa, where a few pairs still breed, and it is still fairly common on the prairies as a migrant, though much less abundant than before. Fifteen years ago flocks of hundreds, or even thousands, were frequently seen trooping over cornfields and plowed ground in the early spring in Winnebago and Hancock counties." Gabrielson (1907) considered this species as a fairly common migrant in Clay and O'Brien counties about 1910, when flocks of from forty to fifty were often seen standing about in the cornfields or drifting along in great spirals far overhead.

There are several recent observations recorded for the Sandhill Crane. Gabrielson (1918) noted a flock of thirty-five seen April 1, 1913 in Marshall County. Spurrell (1917) had eight spring migration dates in the twelve years from 1904 to 1915. Stephens (1920) recorded that one was shot September 15, 1918, near the "High Bridge" over the Missouri River, within the city limits of Sioux City. It was too badly damaged for mounting. DuMont (1931) recorded single birds seen in Polk County, April 16, 1928 and during April, 1929. A small flock was seen along the Missouri River in 1931 by William Schuenke. There are a number of Iowa specimens.

Family Rallidae

Rallus elegans elegans Audubon. King Rail

An uncommon migrant, and a somewhat rare summer resident, breeding in favorable localities. The King Rail has become greatly reduced as a breeder in Iowa during the past two decades, due to the extensive draining and drying up of many marshy areas within the state. This species is unreported by some observers and considered as quite rare by others. However, Spurrell (1917) recorded it as a common breeder in Sac County.

Rallus limicola limicola Vieillot. Virginia Rail

An uncommon migrant and a decidedly uncommon or rare summer

resident. Whether this species is actually less numerous than the King Rail as a breeder in Iowa has not been determined. The reports on rails of all sorts, both as migrants and breeders, are so few that it is impossible to determine whether all these birds are becoming scarce in Iowa due to the disappearance of the marshes or to a lack of interest in the study of this group.

Porzana carolina (Linnaeus). Sora

A common migrant, and a fairly common summer resident, breeding throughout the state, but most numerous in the northern half.

Coturnicops noveboracensis (Gmelin). Yellow Rail

A fairly rare migrant, found occasionally in summer. Anderson (1907) listed the following records: one taken in Blackhawk County; one noted in Dickinson County in the fall of 1895; a specimen, No. 8948, female, taken May 27, 1892, in Johnson County, was formerly in the University of Iowa Museum; rare spring migrant in irregular numbers in Lee County; one shot September 9, 1898, in Scott County; a male and female, now in the University of Iowa Museum, were secured by Paul Bartsch September 9, 1898 across the river from Burlington, in Henderson County, Illinois. Widmann (1907) stated that E. S. Currier regarded them as irregular transients at Keokuk. W. E. Praeger found them common April 22, 1888 and April 21, 1889 at Sand Ridge, Clark County, Missouri.

There are several recent records of the Yellow Rail. Two specimens in the Bullock collection, Des Moines, were taken by D. J. Bullock during September, 1928 in Story County. Two mounted specimens now in the University of Iowa Museum, were taken at Homestead, Iowa County, by L. W. Dean. Both are males collected April 23, 1922 and April 22, 1923. A female in the museum was caught inside the Armory at the University of Iowa, Iowa City, May 18, 1933. One in the collection at Coe College was taken by W. F. Kubichek in Johnson County. One in the museum of Iowa Wesleyan College, Mt. Pleasant, was secured April 15, 1886 at Burlington, Des Moines County. Pierce (1930) stated that one was flushed from the marsh grass at Independence mill-pond by Vance Allyn on May 16, 1926. An adult specimen labeled "Black Rail" is in the collection at Iowa State Teachers College, Cedar Falls. DuMont (1931) records one seen at Des Moines, May 4, 1925, by Arthur T. Watson. In a letter to the U. S. Biological Survey, August 15, 1922, W. J.

Kubichek reported taking three specimens in Monroe Township, Johnson County.

The only evidence that the Yellow Rail ever nested in Iowa is furnished by John Krider (1869) who stated: "It breeds in Iowa, where I found its nest with eight eggs."

Creciscus jamaicensis stoddardi Coale. Black Rail

Very rare. Anderson (1907) recorded several occurrences of this species in Iowa as follows: "County records: Blackhawk—'rare migrant; one specimen mounted' (Walters). Des Moines—'Burlington, Iowa, 1892—specimen in flesh examined by me' (Nutting, Proc. Iowa Acad. Sci., 1892, 41). Lee—'very rare—Keokuk district' (Praeger). Linn—'a set of eggs was found by myself in 1899, too far incubated to save' (Berry). Van Buren—'some 17 or 18 years ago a farmer caught one with his hands while plowing in a swamp and brought it to me. This is the only time I have known it to occur here—Hillsboro' (W. G. Savage). Webster—'rare; July 11, 1899, killed a small rail of some sort new to me, along the edge of the slough in Black's field just east of the rendering works (Fort Dodge). It is 5½ inches in length; dark slate on head and breast, back dark brown tinging to a reddish at back of neck' (Somes)." The specimen mounted by Walters has been examined by the writer and found to be an adult Yellow Rail. There is no evidence that the specimen examined by Nutting was preserved. Widmann (1907) recorded that one was seen at Iowa City, Johnson County, October 11, 1885.

There are but two recent observations, both by E. D. Nauman of Sigourney. He records (Wilson Bull., XXXIV, pp. 217-19) one seen May 5, 1914 as it flew from the marsh grass within four or five feet of him. Nauman said in a letter that this bird was distinctly a rail, black, and too small for any other species. At that time of year it could hardly have been the young of any other species of rail. Another was seen by him at Sigourney, October 1, 1925. The writer has been unable to find an Iowa specimen.

The only basis for considering the Black Rail as a breeding bird in Iowa is the statement by George H. Berry that he took a set of eggs in Linn County in 1899. Some question has arisen recently in regard to the veracity of several of Berry's records. Therefore it seems advisable, as the eggs were neither preserved nor examined by a trained ornithologist, to remove this species from the list of Iowa breeding birds.

Gallinula chloropus cachinnans Bangs. Florida Gallinule

An uncommon migrant, and a somewhat rare summer resident, breeding sparingly throughout the state, most numerous in the north-west part.

Fulica americana americana Gmelin. American Coot

A very common migrant along the larger rivers of the state and common through the interior. The "Mud Hen" is an uncommon summer resident and breeder in the southern and eastern portions of the state and a numerous breeding bird in the northwest.

Order CHARADRIIFORMES

Family Charadriidae

Charadrius melodus Ord. Piping Plover

A rare migrant and a casual summer resident. The records of this species as listed by Anderson (1907) were divided between the two subspecies *Ægialitis meloda* [*melodus*] and *Æ. m. circumcincta*. The latter is not now accepted as a valid race. This bird was formerly more numerous as a migrant, but at the present time is reported only from the Sioux City region. Roberts (1932) records two recent occurrences in southwestern Minnesota and three observations in the southeastern part. William Youngworth found this species breeding three miles west of Sioux City in South Dakota, during 1932. The evidence of its former breeding in the state is negligible. Cooke (1888) stated that it was reported as breeding at Grinnell.

The only Iowa specimen is a male in the University of Iowa Museum, taken at Burlington, Des Moines County, August 27, 1893, by Paul Bartsch. Another specimen in the same collection, a juvenal male, was taken by Bartsch, August 21, 1892 at Burlington, but nearer the Illinois than the Iowa side.

Charadrius semipalmatus Bonaparte. Semipalmated Plover

A fairly common migrant, at times appearing in numbers. The abundance of this species depends very largely upon the presence of mud-flats and in localities where these are lacking the bird is but rarely found. When the water level drops, the ponds and sloughs in the state are so quickly overgrown by vegetation that few feeding or resting areas are available except along the larger rivers.

The Semipalmated or "Ring-necked" Plover does not breed in Iowa. There are a number of specimens.

Oxyechus vociferus vociferus (Linnaeus). Killdeer

A very common migrant, and common summer resident, breeding throughout the state.

Pluvialis dominica dominica (Müller). American Golden Plover

Spring and fall migrant. This species was reported by Trippe (1872) as abundant in the spring and fall in Decatur and Mahaska counties about 1870. After 1910 it was greatly reduced in numbers and was of rare occurrence in the state. Recently it appears to have increased somewhat, and, while still reported as rare in a number of localities, it may be considered as an uncommon migrant, most frequently heard flying over, or stopping occasionally on burnt-over ground or tracts of original prairie sod. There are no records of breeding.

Squatarola squatarola (Linnaeus). Black-bellied Plover

Somewhat rare migrant. This species appears to be increasing in numbers and has recently been reported from the following counties: Clayton (Allert); Chickasaw (Spiker); Buchanan (Pierce, Harry Sanderson); Johnson (specimen, Kubichek; specimen, Tracy Jones; W. C. Thietje; Roberts); Polk (John E. Stewart); Boone (Rosene); Palo Alto (specimen, Iowa Fish and Game Commission); Woodbury (Youngworth, A. J. Anderson). There are several other Iowa specimens.

Arenaria interpres morinella (Linnaeus). Ruddy Turnstone

A rare migrant. Anderson (1907) listed records of this species from Winnebago, Des Moines, Linn, and Mills counties, and he mentioned two specimens taken by Paul Bartsch at Burlington, Des Moines County, May 21, 1892. These specimens, both males, are in the University of Iowa Museum. It was reported as a rare migrant in Woodbury County (Bennett, 1931); one was seen in Polk County, June 5, 1926, by Arthur T. Watson (DuMont, 1931); and Harlan reported two seen in the same locality during the fall of 1932. The writer observed a single bird at Little Wall Lake, Hamilton County, June 11, 1928. A flock of fifteen was seen by Roberts at Spirit Lake, Dickinson County, during the spring of 1929. Single individuals were seen by Roberts in the same locality on three dif-

ferent occasions but no dates were recorded. Besides the two specimens mentioned above there are two others from Burlington, now in the Museum of Iowa Wesleyan College, Mt. Pleasant.

Family Scolopacidae

Philohela minor (Gmelin). American Woodcock

A decidedly uncommon migrant and a rare summer resident in the eastern half of the state; recently reported as breeding in Story, Boone, Washington, Blackhawk, Clayton, and Allamakee counties.

The earlier writers recorded this species as common in all of the wooded localities, but by 1900 it was considerably reduced in numbers. Anderson (1907) stated that all observers who reported the Woodcock considered it a rare summer resident in Iowa. The writer has been unable to find any recent records of this species from the western third of the state.

Capella delicata (Ord.). Wilson's Snipe

A common migrant, frequently arriving in March and remaining in suitable localities for several weeks. In the fall the "Jack Snipe" may occasionally linger until late in November. Noted in Polk County December 26, 1930, December 26, 1932, and February 8, 1931. Anderson (1907) recorded it as breeding in Winnebago and Kossuth counties. Reported recently as breeding in Story County (Hendrickson). DuMont (1931) recorded that a nest with four eggs was found May 15, 1927, at Des Moines, Polk County, by Arthur T. Watson. A single bird was flushed from the same field June 3, 1929, by Watson and the writer.

Numenius americanus americanus Bechstein. Long-billed Curlew

Very rare migrant. Formerly a common summer resident, breeding in the northern part of the state. However, there are no nesting records since 1890, or a little earlier. The observations during the past twenty-five years are very few. The following notes from the Sioux City region were contained in a letter from T. C. Stephens, January 30, 1933: "A. J. Anderson, taxidermist, told me of seeing two of these curlews alight on a sandbar in the Missouri River about opposite Crystal Lake on October 25, 1914. He said that the two birds had bills of different lengths, which he attributed to age. He was quite positive of his identification. On May 14, 1921, Anderson told me of seeing a Long-billed Curlew (on this date) at a

slough between Salix and Sergeant Bluff." Fenton (1923-24) said that he saw two birds in Floyd County, April 14, 1918, that were without doubt of this species. One was seen by Walter Rosene and Robert Walker of Ogden, Boone County, on May 15, 1932, in a marshy pasture four miles north of Ogden. Rosene, well acquainted with this bird on its breeding ground in western Nebraska, recognized the call immediately and observed it for several minutes which allowed a study of head markings and a comparison of size.

Few Iowa specimens with data are preserved. A female, No. 10662, in the University of Iowa Museum, was taken at Wolf Creek Slough, Woodbury County, April 8, 1884 by D. H. Talbot. The exposed culmen measures 198.1 mms. One in the Shaffer collection was taken in Jefferson County by C. S. McElhinny, but no date was recorded. The great length of the bill would indicate that it was a female. One in the Odebolt High School was collected by H. B. Smith in Sac County. The exposed culmen measures 200.6 mms. One in the Philadelphia Academy of Natural Sciences was taken in Dickinson County, June 10, 1881, by W. L. Abbott. No. 10151, in the Davenport Public Museum, was taken by S. C. Bowman in Iowa.

Phaeopus hudsonicus (Latham). Hudsonian Curlew

A casual visitor. Anderson (1907) states: "I have a female specimen of the Hudsonian Curlew in my private collection, shot on the prairie west of Crystal Lake, Hancock County, May 25, 1895. The bird was alone and very wary and much careful stalking was necessary in order to secure it." In a letter from Anderson he says: "There was no mistake about the identity, as the bird had the light median crown stripe. I kept the specimen for some time, but my recollection is that the dermestes ate away most of the membrane from the bill and part of the head feathers around base of bill, and probably the skin was discarded later." This is the only Iowa record.

Phaeopus borealis (Forster). Eskimo Curlew

Extinct in Iowa. It had been greatly reduced in numbers before 1907, when Anderson wrote of it as follows: "The Eskimo Curlew is also a rare migrant in Iowa. It was listed by Allen (White's Geol. of Iowa, ii, 1870, 426), and John Krider says: 'I found it in Iowa in May, migrating westward' (Forty Years' Notes, 1879, 68).

"County records: Des Moines—Mus. No. 16803, taken at Burlington, April 5, 1893, by Paul Bartsch. Jackson—'rare transient' (Giddings). Johnson—specimens in University museum taken by Frank Bond (Nutting, Proc. Iowa Acad. Sci., 1892). Van Buren—'spring migrant, very rare' (W. G. Savage)." The specimen taken by Bartsch is now mounted in the University of Iowa Museum, but those taken by Bond cannot be found. There appear to be no Iowa records of the Eskimo Curlew after 1893. The writer recorded (1931) that a pair was shot by C. H. Schroeder at Des Moines, Polk County, about 1893. These specimens were presented to the Iowa State Historical Society, but cannot now be found. Besides the Bartsch bird the only other Iowa specimen is a female, No. 10158, in the Davenport Public Museum. It was collected by S. G. Bowman, April 20, 1874, in "Northern Iowa."

Bartramia longicauda (Bechstein). Upland Plover

An uncommon migrant and summer resident, somewhat localized; greatly reduced in numbers. It is reported as breeding in the following counties: Clayton, uncommon (Allert); Chickasaw, common (Spiker); Buchanan, fairly common (Pierce, 1930); Story, one pair found about every two square miles near Ames (Hendrickson); Polk, rare (DuMont, 1931); Boone, only a few found (Rosene); Dickinson, rare (Roberts). It was recorded as a migrant in Woodbury County, uncommon (Bennett, 1931), and as rare (Youngworth). Spurrell (1917) stated that it was a tolerably common spring and fall migrant in Sac County. Gabrielson (1918) classed it an uncommon fall migrant and mentioned that several years before, they had bred in considerable numbers in northwestern Iowa.

Actitis macularia (Linnaeus). Spotted Sandpiper

A common migrant and a fairly numerous summer resident, breeding throughout the state.

Tringa solitaria solitaria Wilson. Eastern Solitary Sandpiper

A fairly common migrant along all of the rivers and streams in the state. Anderson (1907) stated that it was found occasionally in summer; he called attention, however, to the difficulty of finding its nest, and mentioned that none had been recorded as found in Iowa. There are no recent reports of probable breeding.

Catoptrophorus semipalmatus inornatus (Brewster). Western Willet

A fairly rare migrant. Unreported by several observers in the state, and classed as rare by all in the eastern half of Iowa. Bennett (1931) recorded it as an uncommon migrant in the Sioux City region, and as formerly nesting. In listing the records of the Willet in Iowa, Anderson (1907) included both *Symphemia semipalmata* [*semipalmatus*] and *S. s. inornata*. The records of the former were, in no case, based on specimens; this may be attributed to the fact that the subspecies *inornatus* had not been recognized when the earlier records were published. Three specimens in the University of Iowa Museum, from Des Moines, Johnson, and Marshall counties, all are referable to *inornatus*. Breeding records were listed by Anderson from Jasper and Sioux counties. There are no recent reports of breeding.

Totanus melanoleucus (Gmelin). Greater Yellow-legs

A fairly common spring and fall migrant, fluctuating somewhat in numbers, and seldom as numerous as *Totanus flavipes*. Reported by a few observers as rare, or seen irregularly. There are no breeding records.

Totanus flavipes (Gmelin). Lesser Yellow-legs

A common spring and fall migrant in all parts of Iowa. It is not known to breed in the state.

Pisobia melanotos (Vieillot). Pectoral Sandpiper

A common spring and fall migrant. Its distribution in the state is widespread, due primarily to its habits of feeding in the grassy meadows as well as on the mud flats along the streams and lakes. There are no breeding records.

Pisobia fuscicollis (Vieillot). White-rumped Sandpiper

A fairly common migrant in the spring and fall. Recorded by Anderson (1907) as the Bonaparte Sandpiper. So very little attention is paid to the shore birds by the majority of bird students, that it is not surprising that so few reports of this bird and the Baird's Sandpiper were received. During the last half of May in central Iowa the flocks of sandpipers consist, in about equal numbers, of White-rumped, Baird's, and Semipalmated. The bulk of the Pectoral and Least Sandpipers, as well as both of the Yellow-legs, have moved north-

ward by that time, and the Ring-necked Plover is the only other shore bird found in any numbers in these mixed flocks. There are a few Iowa specimens.

Pisobia bairdi (Coues). Baird's Sandpiper

A fairly common spring migrant, less numerous in the fall. It is about equal in numbers with *Pisobia fuscicollis*, with which it is associated during late spring migration. There is but one fall record of it in Polk County (DuMont, 1931), but Gabrielson (1918) recorded this bird as tolerably common from August 15 to September 7, 1914. Unreported by several observers in the state, and a few reported it as rare. There are several Iowa specimens.

Pisobia minutilla (Vieillot). Least Sandpiper

A common spring and fall migrant. A report of a set of eggs taken by Joseph Brown of Norway, Benton County, recorded by Anderson (1907) unquestionably is a mistake. Admission is made by Brown's daughter that the notebook which contained data to her father's egg collection was lost.

Pelidna alpina sakhalina (Vieillot). Red-backed Sandpiper

An irregular spring and late fall migrant; occasionally appearing in some numbers. Allert classed it as an uncommon migrant in Clayton County; Roberts reported it as rare in Johnson County; Kubichek took three specimens at Swan Lake, Johnson County, May 21, 1931; Nauman considered it very rare in Keokuk County; DuMont (1931) listed three Polk County records and stated that J. R. Harlan collected two specimens from a flock of more than a hundred birds; Gabrielson (1918) recorded four seen October 6, 1913, and sixty October 10, 1913, when five were collected; Rosene said it was accidental in Boone County; Spurrell (1917) recorded it as rare in Sac County; and Youngworth reported it as rare in Woodbury County.

Limnodromus griseus griseus (Gmelin). Eastern Dowitcher

A rare migrant. In this study sight records have been entirely disregarded. Certain specimens collected in Iowa have bills measuring less than 68.0 mm. in the females, and less than 60.0 mm. in the males. There are certain minor color differences between these specimens and those of *scolopaceus*. These differences are inconstant and appear to be the result of wear.

The breeding bird of Alberta and Manitoba, supposedly intermediate in size between *griseus* and *scolopaceus* has been described as new by William Rowan (Auk, XLIX, pp. 14-35) and named *L. g. hendersoni*. If this so-called Inland Dowitcher is given a place in the next A. O. U. Check-List these short-billed Iowa specimens may be assigned to it instead of to *griseus*.

However, Pierce Brodtkorb, of the University of Illinois, has recently examined two specimens which the writer considered referable to *hendersoni*. He wrote that these two juvenal birds were clearly *griseus*. Both are in the University of Iowa Museum. No. 16290, a female, was collected by Paul Bartsch at Burlington, Des Moines County, August 16, 1893. The culmen measures 62.4; wing 150.0; and tarsus, 38.2. No. 28662, is probably a female, and was collected by Ira N. Gabrielson at Marshalltown, Marshall County, August 10, 1914. The culmen measures 60.9; wing, 146.0; and tarsus, 35.4. Additional specimens are needed.

Limnodromus griseus scolopaceus (Say). Long-billed Dowitcher

A fairly rare migrant in all parts of the state. It was reported as an uncommon migrant in Woodbury County (Bennett) and in Polk County (DuMont). This bird was originally described by Thomas Say as *Limosa scolopacea*, from several specimens collected near Boyer Creek, Pottawattamie County, Iowa.

There are several specimens in which the bill of the female exceeds 68.0 mm., and that of the male, exceeds 60.0 mm.

Micropalama himantopus (Bonaparte). Stilt Sandpiper

Fairly rare migrant. Anderson (1907) listed this bird from Floyd, Allamakee, Des Moines, Winneshiek, Mills, and Pottawattamie counties. All but the last two reports were based on collected specimens. At present an uncommon migrant in the Sioux City region (Bennett, 1931, and Youngworth). Tinker (1914) recorded that two adult males were taken by Ruthven and Peet at a small pond near Virgin Lake, Palo Alto County, August 15, 1907. An adult female was secured by the same collectors in Clay County, August 27, 1907. Logan J. Bennett wrote that he observed five of these birds and collected one on Green Slough, Clay County, May 16, 1933; he saw another on Virgin Lake, May 26, 1933. Spurrell (1917) recorded it as a rare migrant in Sac County. Rosene reported it rare in Boone County. DuMont (1931) recorded three Polk County ob-

servations, and one bird was seen there by Rosene, May 14, 1932. Roberts reports it as rare in Johnson County. Only two Iowa specimens have been examined. A male, No. 16505, in the University of Iowa Museum, was secured at Burlington, Des Moines County, by Paul Bartsch on September 28, 1889. A female, No. 2261, Coe College Museum, was taken at Swan Lake, Johnson County, by W. F. Kubichek, May 21, 1931.

Ereunetes pusillus (Linnaeus). Semipalmated Sandpiper

A fairly common spring and fall migrant, reported as common in several localities and as a rare migrant in Keokuk County (Nauman), and Chickasaw County (Spiker).

Ereunetes maurii Cabanis. Western Sandpiper

The present status is undetermined. The only Iowa record is of two males and a female, collected by Paul Bartsch at Burlington, Des Moines County, October 15, 1895. These specimens are in the University of Iowa Museum. This species has been reported as a migrant at Lincoln, Nebraska, during September and October. In eastern South Dakota it has been collected in April. Gault (Check-List, Birds of Illinois) records this species as an uncommon migrant. No doubt a little more collecting of small shore birds would reveal this bird to be a regular migrant through Iowa between the breeding grounds in Alaska and the eastern part of its wintering area along the Atlantic coast from the Carolinas southward.

Tryngites subruficollis (Vieillot). Buff-breasted Sandpiper

A rare spring and fall migrant. DuMont (1931) recorded four observations in Polk County as follows: "April 30, 1927 (Watson and Nelson); May 5, 1927 . . . (Watson); May 20, 1923 and May 14, 1924 (Nelson)." Nauman reported it as rare in Keokuk County. Bennett (1931) recorded it as rare in the Sioux City region; specimens taken by D. H. Talbot, August 2, 1884. These specimens, two males, are in the University of Iowa Museum. A third specimen, without data, was probably taken at the same time. Fenton (1923-24) says: "I have one specimen, secured near Charles City on September 9, 1915. The specimen was identified by Dr. B. H. Bailey." Fenton wrote that he believed that the specimen had since been discarded.

Limosa fedoa (Linnaeus). Marbled Godwit

A very rare migrant. Anderson (1907) stated that it was formerly

a fairly common migrant, and nesting records were listed for Pottawattamie, Kossuth, Cerro Gordo, Sioux, and Winnebago counties. However, there are no breeding reports after 1890. Spurrell (1917) said that it was reported by Lee as formerly common in Sac County and that nests with eggs had been reported. A specimen taken by H. B. Smith in Sac County is in the Odebolt High School. Bennett (1931) recorded it as an uncommon migrant in the Sioux City region. Roberts observed one May 12, 1927 at Spirit Lake, Dickinson County. Reported seen at Carter Lake, Pottawattamie County, April, 1928 (Letter of Information, Nebr. Orni. Union). There are seven specimens in the Philadelphia Academy of Natural Sciences, taken by W. L. Abbott. Five were taken in Palo Alto County during June, 1881, and two in Dickinson County, June 12, 1881. One in the Coe College Museum was secured at Eagle Lake, near Britt, Hancock County by James Ward, May 6, 1913. No. 10154 in the Davenport Public Museum, was collected by Wm. L. Allen in Scott County.

Limosa haemastica (Linnaeus). Hudsonian Godwit

A rare migrant. Anderson (1907) considered this even rarer than *Limosa fedoa*. He listed records from Blackhawk, Monona, Webster, and Woodbury counties, all based on specimens. At present it is considered an uncommon migrant in the Sioux City region (Bennett, 1931), and as rare in the same locality (Youngworth). Logan J. Bennett wrote that during 1933 he observed one on Trumbull Lake, May 7; one on Mud Lake, May 17; and one on Green Slough, May 21, all three localities in Clay County. Rosene reports it as rare in Boone County. Single birds were seen May 17, 1921 and May 15, 1932. A specimen taken by H. B. Smith in Sac County is in the Odebolt High School. Three birds were seen by Harlan during the spring of 1929, in north Des Moines, Polk County, and one was collected May 3, 1931, in the same locality. It is in the State Historical Museum, Des Moines. Two were seen at Swan Lake, Johnson County, by Roberts two different times during May, 1931. A female, now in the Coe College Museum, was collected at Swan Lake, by Kubichek, May 23, 1931. Two in the Museum of Iowa Wesleyan College, Mt. Pleasant, were taken at Burlington, Des Moines County, May 2, 1887. No. 10149, in the Davenport Public Museum was collected by W. C. Putnam in Hardin County. A female, No. 17093, in the University of Iowa Museum was secured by J. F. Baker at Sioux City. There are no breeding records.

Crocethia alba (Pallas). Sanderling

A rare migrant. The county records given by Anderson (1907) would indicate that it was formerly an irregular migrant along the Mississippi and Missouri Rivers. Recently reported as a rare migrant at Sioux City (Youngworth). DuMont recorded (Wilson Bull., XLIV, p. 173) a single bird at Long Pond, Dallas County, June 6, 1928. Reported as a rare migrant in Johnson County (Roberts). Two specimens in the museum of Iowa State Teachers College were collected at Cedar Falls, Blackhawk County, October 6, 1908. Two males, now in the Coe College Museum, were secured at Swan Lake, Johnson County, by Kubichek, May 21, 1931. A female, No. 16339, in the University of Iowa Museum, was collected at Burlington, Des Moines County, October 15, 1895.

Family *Recurvirostridae**Recurvirostra americana* Gmelin. Avocet

A rare migrant. Anderson (1907) cited the record of Thomas Say, who observed it at Engineer Cantonment, February 20, 1820. Occurrences were reported from the following counties: Sioux, Woodbury, Dickinson, Pottawattamie, Mills, Johnson, and Lee. A single breeding record is given for Sioux County: "June 2, 1900, I collected a set of four eggs of the American Avocet but was unable to blow them as they were too far advanced. I saw two or three pairs of the birds; locality, prairie, about three miles east of Hawarden (Berry)." Spurrell (1917) states that Henry Colburn of Sac City killed twenty Avocets along the Cedar Creek in 1894. In the fall of 1914 Spurrell saw two birds along the inlet of Wall Lake which probably were this species. Bennett (1931) records: "Formerly common (Thos. Say), formerly nesting (Berry, at Hawarden, 1900), now rare migrant." DuMont (1931) states that two birds were seen at Des Moines, Polk County, by A. T. Watson, May 27, 1927. A flock of six was seen in the same locality by Winifred Gilbert during the spring of 1925. An immature specimen, taken in Cedar County, September 17, 1910, is in the Coe College Museum. Three specimens are in the University of Iowa Museum. No. 18535, a female, was taken by H. C. Fairchild, near Iowa City, Johnson County, April 22, 1902. No. 28710, a female, was secured by Fred Stevens at Onawa, Monona County, October 1, 1929. No. 28711, was collected near Coralville, Johnson County, about 1930.

Himantopus mexicanus (Müller). Black-necked Stilt

A casual visitor. Anderson (1907) included five dates of occurrence for the vicinity of Omaha, and listed the following county records: "Mills-Pottawattamie—'scarce migrant' (Trostler). Sioux—'shot one female at Hawarden in 1890' (Berry). Webster—'several were killed here in summer of 1898'—Fort Dodge (Somes). Wayne—(Brown). Woodbury—'rare transient—Sioux City' (Rich)." Cooke (Bio. Sur., Bull., 35, p. 21) recorded one seen by Rich at Sioux City, April 20, 1902. Reported at Carter Lake, Pottawattamie County, May 9, 1928 (Letter of Information of the Nebr. Orni. Union). Pierce (1930) recorded that a pair was seen frequenting some flood ponds north of Lamont, Buchanan County. The birds were discovered during August, 1924 by Mrs. R. I. Bordner, who saw them almost daily until September 8, 1924. There are no Iowa specimens.

Family **Phalaropodidae***Steganopus tricolor* Vieillot. Wilson's Phalarope

A fairly common migrant. Formerly a common summer resident, breeding in the northern part of the state. The lack of recent breeding records in Iowa coincides with the conditions pertaining in Minnesota. Roberts (1932) states that it disappeared as a breeder about 1900 and only within the last few years is returning to its former nesting areas. Some observers reported this Phalarope as irregular or rare. There are several specimens.

Lobipes lobatus (Linnaeus). Northern Phalarope

An uncommon migrant along the Missouri River Valley, rare in the other portions of the state. Reported from the following counties: Woodbury, uncommon migrant (Bennett); Emmet, rare migrant (Wolden); Boone, rare (Rosene); Johnson, rare migrant (Roberts). There are two Iowa specimens, a male, No. 16525 in the University of Iowa Museum, taken by Paul Bartsch at Burlington, Des Moines County, August 10, 1894, and a female in the Coe College Museum, taken by W. F. Kubichek at Swan Lake, Johnson County, May 21, 1931.

Family **Stercorariidae***Stercorarius parasiticus* (Linnaeus). Parasitic Jaeger

A casual visitor. An immature male, No. 25004 in the University of Iowa Museum, was shot on the Des Moines Rapids of the Mis-

Mississippi River, near Keokuk, on October 6, 1896. The skin was prepared by William E. Praeger who later donated it to the Museum. A specimen in the Coe College Museum was secured by James Ward, September 20, 1905, at Eagle Lake, near Britt, Hancock County. It is an immature bird, probably a female. There are no other Iowa records.

Stercorarius longicaudus Vieillot. Long-tailed Jaeger

Accidental. R. M. Anderson recorded (Auk, XXV, p. 215) the capture of a fully plumaged female killed by Charles Prizler near Lone Tree, Johnson County, June 15, 1907. The specimen is mounted in the University of Iowa Museum.

Family **Laridae**

Larus argentatus smithsonianus Coues. Herring Gull

A fairly common migrant along the larger rivers of the state, less numerous through the interior. Bennett (1931) records it as a common winter resident in the Sioux City region.

Larus delawarensis Ord. Ring-billed Gull

A fairly common migrant throughout the state. Somewhat more numerous through the interior than the Herring Gull, and arriving approximately two weeks later in the spring. There are no breeding records.

Larus pipixcan Wagler. Franklin's Gull

A common migrant in the western part of the state, reported as uncommon or rare in the eastern portion. The phenomenon of the autumnal concentration of these birds about the lakes in Dickinson County has been described by Aldo Leopold (Wilson Bull., XLIV, p. 116) and F. L. R. Roberts (Iowa Bird Life, II, pp. 26-27) when many thousand were present. There are several reports of this bird as a summer resident. Roberts (1932) stated that during a visit to Heron Lake, Jackson County, Minnesota, in June, 1916, the nests of this gull were estimated to be at least fifty thousand. However, evidence of its breeding in Iowa is lacking.

Larus philadelphia (Ord). Bonaparte's Gull

An irregular and uncommon migrant frequenting the lakes and larger rivers of the state. Rare through the interior. Reported by

Allert as a common migrant along the Mississippi River at McGregor. There are several Iowa specimens.

Rissa tridactyla tridactyla (Linnaeus). Atlantic Kittiwake

Accidental. An immature male was collected by James R. Harlan at Des Moines, Polk County, on November 22, 1931. The specimen is mounted in the collection of the State Historical Museum, Des Moines. Full details of its capture were recorded by the writer (Auk, L, pp. 102-103).

Xema sabini (Sabine). Sabine's Gull

A casual visitor. There are three Iowa specimens. Two in the University of Iowa Museum were taken by Paul Bartsch at Burlington, Des Moines County. No. 15981, a male (?), was secured October 15, 1891, and No. 15982, a female, was collected October 12, 1894. One in the Davenport Public Museum, No. 10215, was taken in Scott County, by W. L. Allen. Date and sex were not recorded.

Sterna forsteri Nuttall. Forster's Tern

A fairly common migrant in all parts of the state. There are no breeding records. On the basis of specimens this bird is considerably more numerous than *Sterna hirundo*. Due to the difficulty of determining between the two in the field, except in winter plumage, sight records have been disregarded in this summary and specimens alone have been used as an index to the comparative abundance of the two. Anderson (1907) recorded specimens from Cerro Gordo, Dickinson, Johnson, and Linn counties. Others have been examined from Johnson, Sac, Dickinson, and Polk counties. There are seven specimens in the Coe College Museum, and five in the Philadelphia Academy of Natural Sciences, the latter taken in Palo Alto County during June, 1881, by W. L. Abbott. It has been reported as a breeder at Heron Lake, Jackson County, Minnesota and may be found nesting in northwestern Iowa.

Sterna hirundo hirundo Linnaeus. Common Tern

An uncommon migrant. Anderson (1907) listed specimens from Johnson and Des Moines counties. There are two males and three females in the Coe College Museum, taken by George H. Berry and B. H. Bailey on May 13, 1913 at Cedar Rapids, Linn County. One in the collection of Otto W. Remer was secured at Le Mars, Plymouth County, and was received for mounting by A. J. Anderson,

Sioux City taxidermist, on October 5, 1919. This appears to be the only record for northwestern Iowa.

Sterna antillarum antillarum (Lesson). Least Tern

An uncommon summer resident. Anderson (1907) recorded it from Cerro Gordo, Pottawattamie, Lee, Linn, Polk, Sioux, and Winnebago counties, with reports of former breeding in Cerro Gordo and Pottawattamie counties and probable nesting in Lee County. Spurrell (1917) stated that it was a rare migrant in Sac County. A dead bird was found at Wall Lake, September 29, 1912. Four were seen at the Lake, June 19, 1916. Mrs. John E. Stewart recently noted it throughout the breeding season at Des Moines, Polk County. Youngworth (Wilson Bull., XLII, pp. 102-103) recorded the breeding of this tern in the Sioux City region, and on August 3, 1931 noted not less than 150 on a sandbar in the Missouri River (*ibid*, XLIII, p. 309).

Hydroprogne caspia imperator (Coues). Caspian Tern

An uncommon and irregular migrant in the eastern half of the state, principally along the Mississippi River, rare through the interior, and apparently unrecorded from the western portion. Anderson (1907) recorded several occurrences mostly from the Mississippi, Iowa and Cedar Rivers. One only taken in central Iowa. DuMont (1931) stated that one was seen at Des Moines, Polk County, on June 7, 1931, and four at the same place, September 24, 1931; both observations by Mr. and Mrs. John E. Stewart. There are ten specimens in the Coe College Museum, from Hancock, Linn, and Johnson counties, all taken in the fall between September 16 and October 5. Six specimens in the University of Iowa Museum are from Linn, Cedar, Johnson, and Des Moines counties, all taken in the fall.

Chlidonias nigra surinamensis (Gmelin). Black Tern

A common migrant less numerous in the fall. Breeds in the northern part of the state and reported by Wolden as an abundant breeder in Emmet County. It has been found nesting in Dallas County during June, 1932 (Rosene and DuMont) and present during the breeding season in Boone, Hamilton, and Buchanan counties. Reported as a migrant only in Marshall and Clayton counties.

Family Alcidae

Uria lomvia lomvia (Linnaeus). Brünnich's Murre

Accidental. Anderson (1907) listed two specimens which were

found following the storm of December 16, 1896, which resulted in a number of interior records of this bird. One was caught alive at Atlantic, Cass County, December 20, 1896, by Frank Pellett. This mounted specimen, which is now in the possession of T. C. Stephens, Sioux City, was recently examined by Ludlow Griscom of the Museum of Comparative Zoology, Cambridge. It was stated to be a young Brünnich's Murie of the year (Wilson Bull., XLIV, p. 239). The second specimen was found in Johnson County during January, 1897. It was given to George C. Hoover of West Branch who mounted it. The present whereabouts of this bird is not known.

Order COLUMBIFORMES

Family **Columbidae**

Columba livia livia Gmelin. Rock Dove

This is the common Domestic Pigeon which is reared so commonly throughout the state. Occasionally some of these birds revert to the wild state and may be found nesting about the buildings in our cities. Charles J. Spiker has recently recorded (Iowa Bird Life, III, pp. 10-11) two examples of apparent reversion. On September 22, 1932 a flock of at least fifty birds was found about the rock face of an abandoned quarry, a few miles north of Anamosa, Jones County. Since 1917 this dove has frequented the rocky palisades of the Iowa River at Iowa Falls. It is, indeed, difficult to determine when our Domestic Pigeon becomes sufficiently self-sustaining and naturalized to justify its recognition as the Rock Dove.

Zenaidura macroura carolinensis (Linnaeus). Eastern Mourning Dove

A common summer resident, a few remaining each winter. Restricted to the extreme eastern and southeastern part of the state. This darker eastern race appears to intergrade with *marginella*, along the Mississippi River Valley, although the exact range cannot be delineated without additional specimens. A male in the Dwight collection of the American Museum of Natural History, New York City, was taken by W. G. Savage at Hillsboro, Henry County, April 20, 1895. It was examined by J. T. Zimmer who stated that it was clearly referable to *carolinensis*.

Zenaidura macroura marginella (Woodhouse). Western Mourning Dove

A common summer resident, a few remaining throughout the winter. Breeds commonly in all parts of the state except the extreme

east and southeast where it is replaced by the eastern race, *carolinensis*. Breeding specimens from Johnson and Iowa counties were examined by H. C. Oberholser and determined as typical of *marginella*. There are recent reports of its wintering from as far north as Woodbury and Buchanan counties.

Ectopistes migratorius (Linnaeus). Passenger Pigeon

Extinct. Formerly an abundant migrant. Breeding records are extant for Woodbury, Sac, Winnebago, Cerro Gordo, Floyd, and Jackson counties. The last great flights through Iowa were during the years 1868 to 1870 (Herbert Osborn: *Annals of Iowa*, VI, pp. 561-570). By 1880 this "Wild Pigeon" was greatly reduced in numbers and after 1890 there are these few observations which are probably reliable. 1891—Des Moines County, flock of twenty (Paul Bartsch); 1893—Jackson County, one small flock and two single birds (H. J. Giddings); 1893—Franklin County, a flock of twenty birds and one found dead (Frank H. Shoemaker); 1894—Jackson County, small flock (H. J. Giddings); 1894—Lee County, ten pigeons (E. S. Currier); 1895—Winneshiek, small flock seen by a farmer (Carsten C. Smith); 1896—Jackson, a small flock, the last seen (H. J. Giddings); 1896—Lee County, a single female seen May 19, and a young male collected September 7, 1896 (W. E. Praeger); 1897—Floyd County, "The last authentic record is by Clement L. Webster, in 1897" (Fenton); 1899—Lee County, last ones seen May 14, 1899 (E. S. Currier); 1899—Polk County, a flock of twenty-five or thirty reported seen during the fall at Des Moines (Lester P. Fagen); 1903—Kossuth County, "Three were seen April 6, 1903" (W. H. Bingaman). Praeger's specimen is the last one taken in the state. The flock seen by Fagen was unusually large to have been seen at such a late date.

Few Iowa specimens are preserved. Elliott Coues (*Birds of the Northwest*, 1877) listed two males, Nos. 4856 and 4857, as contained in the U. S. National Museum. They were secured at the "Mouth of the Big Sioux" River, Woodbury County, May 3, 1856, by F. V. Hayden, a member of Lieut. Warren's Expedition. The Davenport Public Museum has two mounted birds, Nos. 10334 and 10333, taken by W. L. Allen in Scott County. No date is recorded. There are four birds in the Shaffer collection, Fairfield, probably all secured by J. M. Shaffer in Jefferson County before 1880. Two in the Philadelphia Academy of Natural Sciences, were taken by W. L.

Abbott, one September 7, 1879 in Mitchell County, the other June, 1881, in Palo Alto County. A male, in the possession of O. M. Greenwood, Manchester, was collected by his father, Wm. H. B. Greenwood, in Delaware County, May 10, 1881. Another, taken in the same locality, was disposed of to Frank M. Chapman. The University of Iowa Museum has one secured by John Williams, near Coralville, Johnson County, May 7, 1884. The writer has not learned what became of the bird secured by W. E. Praeger, September 7, 1896, in Lee County.

Order PSITTACIFORMES

Family Psittacidae

Conuropsis carolinensis ludovicianus (Gmelin). Louisiana Paroquet

Extinct. Anderson (1907) has summarized the observations on this bird as contained in the reports of the early explorers up the Missouri River. Thomas Say stated that it was seen several times during the winter of 1819-20 at Engineer Cantonment, near the present site of Ft. Calhoun, Washington County, Nebraska. Prince Maximilian recorded an Iowa observation on May 14, 1834 a little below "Weeping-water River." Audubon and Bell had several observations during May, 1843. The last authentic record is given by T. Martin Trippe (1872): "A resident of Decatur County told me that he had several times seen a flock of Parrots in the southern part of the county on a tall, dead cottonwood tree, known to the neighboring inhabitants as the 'parrot tree,' from its having been frequented at intervals by the same flock for several years . . . and that he had shot one of them on one occasion." There are no Iowa specimens.

Order CUCULIFORMES

Family Cuculidae

Coccyzus americanus americanus (Linnaeus). Yellow-billed Cuckoo

A fairly common summer resident, breeding in all parts of the state.

Coccyzus erythrophthalmus (Wilson). Black-billed Cuckoo

A fairly common summer resident, breeding throughout the state, most numerous in the northern part.

Order STRIGIFORMES

Family Tytonidae

Tyto alba pratincola (Bonaparte). Barn Owl

A rare resident in all parts of the state, somewhat more numerous

in the southern and western portions. Anderson (1907) listed observations or specimens from the following counties: Blackhawk, Franklin, Webster, Woodbury, Cass, Boone, Polk, Poweshiek, Linn, Johnson, Des Moines, Lee, and Wayne. Bailey (1918) added records of occurrences from Mitchell, Floyd, Hancock, Sac, Delaware, Dubuque, and Lucas counties. Stephens and Youngworth have reported seventeen specimens from the Sioux City region of which nine are from Woodbury and Harrison counties. Recently reported from these additional counties: Clayton, Chickasaw, Buchanan, Jackson, Keokuk, and Story.

Family Strigidae

Otus asio naevius (Gmelin). Eastern Screech Owl

A common permanent resident, breeding in all parts of the state. A male, in the gray phase, from Sioux City, Woodbury County, taken during December, 1884, was identified by J. Van Tyne as typical of this subspecies.

Otus asio aikenii (Brewster). Aiken's Screech Owl

Rare in the northwestern corner of the state. Three specimens of this bird have been identified by J. Van Tyne. A male, No. 13183 in the University of Iowa Museum, was collected by J. Fulton at Onawa, Monona County, February 12, 1885. A female, No. 8657, in the same collection, was taken by M. Finnerly at Dakota City, Nebraska, December 22, 1885. A specimen in Youngworth's collection was caught by two boys in Sioux City, Woodbury County, during August, 1932. The sex was not registered.

The writer believes that *aikenii* will prove to be a regular winter visitor into northwestern Iowa. The August specimen must be considered of casual occurrence. Additional specimens are needed to determine the status of these two birds in northwestern Iowa. Aiken's Screech Owl has not previously been reported from Iowa.

Bubo virginianus subarcticus Hoy. Arctic Horned Owl

A casual visitor. There are three Iowa specimens. Two in the University of Iowa Museum were secured during the winter of 1888 and '89. No. 3343, a female, was collected in Johnson County, December 18, 1888, by William Mueller. No. 11612, sex not recorded, was taken by Charles Hagelin, in Woodbury County during February, 1889. Frank E. Ellis reports mounting one during the winter of 1913-14, which was killed on the farm of a Mr. Bolte, four miles

from Maquoketa, Jackson County. The specimen remains in Bolte's possession. The first two specimens were listed by Anderson (1907) under *Bubo v. pallescens* = *occidentalis*, the present race not being included in his report.

Bubo virginianus virginianus (Gmelin). Great Horned Owl

A fairly common resident most numerous in the wooded areas of the south and east, and less so in the northwest away from the Missouri River bottoms. Breeding specimens from all parts of the state are typical of *virginianus*. Several very dark birds, taken in Iowa, have the legs heavily mottled with black, and seemingly are as dark as *saturatus* of the Pacific northwest. These were examined by H. C. Oberholser, who determined them as *virginianus*, pointing out that the rufous cast of this race was retained, although nearly suffused by the duskiness.

Bubo virginianus occidentalis Stone. Montana Horned Owl

An uncommon winter visitor, found in nearly all parts of the state, but most numerous in the northwest. The type specimen of *occidentalis* was secured in Mitchell County, Iowa during the winter of 1880, and subsequently was obtained from the local collector by W. L. Abbott for the Philadelphia Academy of Natural Sciences, where it now is No. 26435.

Anderson (1907) reports three specimens from Hancock County, April, 1891, January 26, 1894, and a male, November 14, 1898. Several specimens are in the University of Iowa Museum. A female, No. 3347, was taken during January, 1887 in Johnson County. A male was secured by P. Dvorsky in Johnson County, January 11, 1907. A male, No. 16172, was collected for Paul Bartsch in Clayton County, January 11, 1896. A female, No. 8698, was secured by one of the Talbot collectors, December 8, 1884, at Little Sioux, Harrison County. A female, No. 11610, was taken by D. H. Talbot at Sioux City, Woodbury County, during 1889. No. 14582 was taken by Talbot collectors at Blue Lake, Monona County, in 1885. No. 15435 is a Talbot specimen with no further data than "Iowa." A male in H. R. Dill's collection was taken by Hewitt at Iowa City, Johnson County, October 23, 1923. No. 881 in the Coe College Museum was secured in Boone County during 1907. One in the Allert collection was secured October 28, 1926 at Beulah, Clayton County. One in the Rosene collection was taken in Boone County. One col-

lected by D. J. Bullock in Story County, during January, 1927 is now in his collection. Harry Tennant has three taken in the vicinity of Arnold's Park, Dickinson County. Otto Remer secured one at Le Mars, Plymouth County. T. C. Stephens (1918) records the following four specimens mounted by A. J. Anderson, former Sioux City taxidermist, during the fall of 1917: November 10, a male from Kelley, Story County; November 19, a female from Alta, Buena Vista County; December 4, a male taken seven miles east of Leeds, Woodbury County; December 5, a male taken near Morningside, Woodbury County. Stephens listed five field observations in Woodbury County between December 16, 1917, and February 17, 1918.

Nyctea nyctea (Linnaeus). Snowy Owl

A fairly rare and irregular winter visitor, probably a few visiting northern Iowa each winter. Periodic invasions have been noted during the winters 1882-83, 1886-87, 1905-06, 1909-10, 1917-18, and 1930-31, when numbers of these birds were collected or seen. T. C. Stephens (1918) recorded forty specimens and six field observations during the winter 1917-18, in the Upper Missouri Valley. Stephens recorded (Wilson Bull., XLV, pp. 83-85) forty-six specimens mounted by A. J. Anderson, former Sioux City taxidermist, between the years 1900 and 1917. DuMont recorded (*ibid.*, pp. 82-83) twenty-three specimens secured by D. H. Talbot and his collectors in northwestern Iowa between 1884 and 1887. Specimens or reports are extant from thirty-nine of the ninety-nine counties.

Speotyto cunicularia hypugaea (Bonaparte). Western Burrowing Owl

A summer resident in the northwest part of the state. Anderson (1907) listed records from six counties. They are as follows: Dickinson—one seen during the fall of 1895, seven miles southwest of Lake Park (Salisbury); Kossuth—one collected two miles south of the Minnesota line, two and one-half miles southwest of Elmore, Minnesota, on June 8 or 9, 1904 (Bingaman); Lyon—Bohumil Shimek reported it fairly common during 1896, two or three being usually seen in a day's drive; Sioux—common summer resident. During 1902 young, unable to fly, were found (Johnson); George H. Berry reported it fairly common around Hawarden in 1890, three males and one female collected; Woodbury—uncommon summer resident, a farmer related that a pair bred on his farm in this county (Rich); a Winnebago Indian reported to I. S. Trostler that this owl had nested

in the northwestern corner of the county during the 1880's; Cherokee—a small colony near Meridan, about 1897. A full set of eggs taken (Frank Bond).

Bailey (1918) added breeding records in southwest Sac County, where the birds were locally distributed, but fairly common in 1916 (J. A. Spurrell). On September 20, 1914 seven members of the Sioux City Bird Club visited a breeding colony of three pairs, eight miles southeast of Sioux City, Woodbury County (A. F. Allen).

Notes furnished from the files of the U. S. Biological Survey are as follows: Sac County—first noted September 16, 1907, observed July 2, 1917, near Wall Lake, five and one-half and three miles south (J. A. Spurrell); Buena Vista—once nested near Marathon (Crane); Osceola County—seen April 22 and 29, 1928 (C. J. Spiker); Woodbury County—last seen October 5, 1924, one (Spiker); one seen April 15, 1925, near Sioux City (Spiker); one seen near Sioux City March 20 and April 6, 1916 (T. C. Stephens).

It was recently reported from Dickinson County by Roberts, Mrs. W. H. March, and Bennett. The latter reported it as probably breeding. He added an observation by M. B. Townsend, one seen June 8, 1911, between Smithland and Sioux City, Woodbury County. Paul L. Errington reports one seen in Lyon County, not far from the South Dakota line, early in July, 1931. Reported by Wolden as a rare breeder in Emmet County. Hendrickson saw a pair near Ocheyedan Mound, Osceola County, in 1928. Gabrielson (1917) reported three pairs nesting at Granville, near the Sioux and O'Brien County line, June 16, 1911. Four birds seen May 9, 1928, near Paton, Greene County, were reported to the late E. W. Sells. He saw two of them May 12. On June 12, one was seen at the same place by Robert Walker, Walter Rosene, Kenneth Nelson, and the writer. Seen again by Rosene on June 26 and six were seen later in the summer by Sells who concluded that four young grew to maturity (Wilson Bull., XLIV, pp. 174-175). The most easterly record in Iowa, and probably in the entire Mississippi Valley region, is reported by Henry Birkeland. During the summer of 1923 a pair nested and reared a family of young in some burrows of his pasture, near Nevada, Story County. The writer has seen no Iowa specimens with data.

Strix varia varia Barton. Northern Barred Owl

A common resident, most numerous along the heavily wooded flood plains of the rivers; breeding in all parts of the state. A darker race,

S. v. brunnescens, has recently been described by Louis B. Bishop (Proc. Biol. Sci. Wash., XLIV, p. 94) in which the light and dark areas are more contrasted, the light areas nearly pure white, lacking the ochraceous of *varia*, and the brown areas more sooty. It is described from a series of eight birds taken in extreme northern Minnesota. If *brunnescens* is recognized in the next A. O. U. Check-List a specimen in the University of Iowa Museum recently examined by H. C. Oberholser must be included. It is a female secured at Coralville, Johnson County, during November, 1928.

Scotiaptex nebulosa nebulosa (Forster). Great Gray Owl

A casual visitor. Anderson (1907) recorded that it was listed by J. A. Allen (White's Geology of Iowa, 1870, p. 424), and it was reported by I. S. Trostler on December 17, 1893 near Omaha (Rev. Bds. Neb., p. 55). Trippe (1872) stated that a very large bird was killed at Oskaloosa in Mahaska County, which, from the description given him by the person who shot it, must have been this species. Walter G. Savage writes from Hillsboro, Henry County: "In 1860 my father shot one. I have not known them to occur since. There is no mistake in this owl. My father shot it in a tree standing in our dooryard one night, and it was nothing else but a Great Gray Owl." David L. Savage, writing in 1894, says: "A friend in Van Buren County shot a Great Gray Owl a few winters ago. This is the only time I ever heard of this species being found in Iowa, but the identity is certain."

A sight record is listed hypothetically by DuMont (1931) because substantiating evidence, in the form of a specimen, is lacking. Four were seen under favorable conditions by A. J. Palas and John Woodmansee in Polk County, December 24, 1922. Nauman reports that one was found during the winter of 1920-21, four miles north of Sigourney, Keokuk County. It was discovered by several boys, high in a tree, and one of them succeeded in hitting it with a thrown club. The bird was caged for several days and during that time Nauman identified it as unquestionably of this species. He noted the great size, large facial disc, yellow eyes, and the lack of ear tufts. (There is some slight discrepancy as to the date of capture. Nauman's report to the writer stated about February 10, while his report to the U. S. Biological Survey gave April 25. He mentions that the ground was covered with snow.) There are no Iowa specimens.

Asio wilsonianus (Lesson). Long-eared Owl

An uncommon or somewhat rare resident in all parts of the state, breeding in suitable localities. As this species is noted more frequently in winter there may be a slight migratory movement from the north.

Asio flammeus flammeus (Pontoppidan). Short-eared Owl

An uncommon winter resident, and a rare summer resident in the northern part. Bailey (1918) reported breeding records for Linn, Boone, Winneshiek, Floyd, Winnebago, Buena Vista, Dickinson, and Emmet counties. Gabrielson (1917) recorded it as a common breeding species in Clay and O'Brien counties. Nauman (1926) recorded a summer observation for Keokuk County in 1916. Spurrell (1917) considered this species a rare breeder in Sac County, and at times an abundant winter resident.

Cryptoglaux acadica acadica (Gmelin). Saw-whet Owl

An uncommon and irregular winter visitor. Unrecorded by a number of observers. There are a number of specimens. Six in the University of Iowa Museum were taken in Woodbury, Boone, Scott, and Johnson counties. Four in the Coe College Museum were taken in Allamakee, Linn, and Iowa counties. Specimens are extant from Sac, Blackhawk, Story, Dallas, and Henry counties.

Anderson (1907) states: "It is known to breed quite regularly across the river from Omaha and probably does on the Nebraska side also" (Rev. Bds. Neb., 1904, 55). Dr. Trostler also records it as a scarce summer resident in Pottawattamie County. D. L. Savage writes: "The 6th of May, 1893, while out in the woods, I shot a female Saw-whet Owl, the first one I have found in this county" (Henry)." The writer knows of no positive breeding records.

Order CAPRIMULGIFORMES

Family Caprimulgidae

Antrostomus vociferus vociferus (Wilson). Eastern Whip-poor-will

An uncommon summer resident, less numerous in the northern part of the state. It has become considerably reduced in numbers since the invasion by the white settlers and the attending destruction of woods and underbrush. Wolden reported it as absent in Emmet County for a number of years, Spiker classed it rare in Chickasaw County, and Nauman reported it rare in Keokuk County. Allert

considers it a common summer resident along the Mississippi bottoms in Clayton County.

Phalaenoptilus nuttalli nuttalli (Audubon). Nuttall's Poor-will

A casual summer resident; a single breeding record. Anderson (1907) says: "Dr. Isidor S. Trostler gives the species as a 'Very rare summer resident in Pottawattamie County. I took a set of two eggs May 5, 1895; bird shot almost to pieces, but enough saved to make identity certain.'" There is no specimen or additional records.

Chordeiles minor minor (Forster). Eastern Nighthawk

A very common migrant, and a common summer resident in all parts of the state except, perhaps, the extreme northwest corner. In a study of this genus, H. C. Oberholser (U. S. Nat. Mus. Bull., 86) restricted the breeding range of *virginianus*=*minor* in Iowa, south and east of Woodbury and Winnebago counties, the northwestern corner being occupied by *Chordeiles m. sennetti*. Specimens nearly intermediate between *sennetti* and *minor*, but nearer the latter race, were examined from Winnebago County, August 12 and 26, 1879, and September 1 and 3, 1879. A single example taken in Dickinson County during June, 1881, was considered nearer *sennetti*. J. Van Tyne wrote that two adult females collected in Clay County, July 8 and 24, 1907, had recently been identified by Oberholser as the typical subspecies. A study of additional breeding specimens is needed to determine the nesting form of the northwest.

Chordeiles minor sennetti Coues. Sennett's Nighthawk

A fairly common migrant in the western half of the state. This may prove to be the breeding form in the northwestern corner of the state (see above). A specimen in the Philadelphia Academy of Natural Sciences was taken in Dickinson County, during June, 1881, by W. L. Abbott. It was identified by Oberholser (*ibid*, p. 52). A specimen in the U. S. National Museum, in juvenal plumage, from four miles southeast of Boone, Boone County, was collected October 27, 1898 by Carl Fritz Henning. A male, No. 17883, in the University of Iowa Museum, was secured by A. G. Frank at Sioux City, Woodbury County, July 21, 1884. This specimen was examined by Robert Ridgway. A specimen in the H. B. Smith collection in the Odebolt High School, was taken in Sac County. Spurrell (1919) reported one seen resting in a plowed field near Wall Lake, Sac

County, August 12, 1909. It was described as a pale silvery color, probably a young bird. One was seen by Mary L. Bailey at Sioux City, September 10, 1930 (Bulletin, Iowa Orni. Union, VII, p. 36). Youngworth considers *sennetti* a common migrant. Stephens, Bennett, and Youngworth believe that the breeding bird in Woodbury County is the darker *minor*. Observed by the writer in Polk County, August 29 and September 18, 1932.

Order MICROPODIIFORMES

Family Micropodidae

Chaetura pelagica (Linnaeus). Chimney Swift

A common summer resident, breeding in all parts of the state.

Family Trochilidae

Archilochus colubris (Linnaeus). Ruby-throated Hummingbird

A common summer resident, breeding in all parts of the state. Reported as fairly common in Story County (Hendrickson) and Emmet County (Wolden). Pierce (1930) recorded it as a scarce summer resident in Buchanan County.

Order CORACIIFORMES

Family Alcedinidae

Megaceryle alcyon alcyon (Linnaeus). Eastern Belted Kingfisher

A fairly common summer resident along all of the streams in Iowa. Reported during the winter from all parts of the state, but most numerous in the southern half.

Order PICIFORMES

Family Picidae

Colaptes auratus luteus Bangs. Northern Flicker

A common summer resident, uncommon in winter, breeding throughout the state.

Colaptes cafer collaris Vigors. Red-shafted Flicker

Typical examples are not frequently noted, but hybrids between this species and *Colaptes auratus* probably occur regularly as migrants along the Missouri River Valley, and occasionally straggle to other parts of the state. Anderson (1907) reported specimens or observations from Blackhawk, Tama, Van Buren, Winnebago, Hardin, Boone, Cass, Sioux, Woodbury, Pottawattamie, and Mills counties.

Trostler, reporting from the last two counties, considered it a summer resident. D. H. Talbot of Sioux City wrote as follows: "While this bird is not common in this part of the state, yet it is very frequently found. I have observed it here nearly every season for twenty-odd years and have secured quite a number of specimens, including several hybrids . . ." (Iowa Orn., i, 3, 1895, p. 74).

Notes from the files of the U. S. Biological Survey contain the following observations: Ashton, Osceola County, seen January 23 and March 26, 1927, and April 7, 1928 (Charles J. Spiker); Ames, Story County, one December 5, 1878 (Henning); Wall Lake, Sac County, one reported (Spurrell).

Spiker (1926) recorded one seen at Quorn, Plymouth County, October 16, 1922 and one along the Missouri River, west of Sergeant Bluff, January 25, 1923. Youngworth (1931) stated that it was a rather common winter visitor in the Sioux City region; two records are November 19 and 23, 1928. DuMont (1931) recorded occurrences in Polk County in 1905, 1906, 1924, and 1928.

Ceophloeus pileatus abieticola Bangs. Northern Pileated Woodpecker

A rare and very local permanent resident, confined to the heavy timber of the south and east. Anderson (1907) stated that it was formerly a not uncommon resident in heavily timbered portions of Iowa, and that an individual or isolated pair was still occasionally reported from localities where belts of native timber remained. Records for the following counties were listed: Winneshiek, Kossuth, Woodbury, Boone, Polk, Decatur, Blackhawk, Linn, Van Buren, and Lee.

Until a few years ago this huge woodpecker seemed doomed to extinction in the state. Surprising enough it appears now to be increasing slightly, and has been reported from several localities. A. J. Palas reported one seen in Allamakee County, June 21, 1931. Allert classed it as a tolerably common permanent resident in Clayton County. Spiker reported it as rare in Chickasaw County. Hendrickson saw one in Blackhawk County in 1924. Pierce observed it in the Backbone State Park, Delaware County, May 21, 1931, September 21, and December 26, 1932. Ellis reported a pair near the old deserted town of Clay Mills, Jones County, two seen in Jackson County, and a specimen taken near Toronto, Clinton County, all within the last few years. Grover C. Hawk reported seeing a pair four different times in Keokuk County. It was noted in the same

county by Nauman, who stated that a few were seen. E. L. Breitenbach has seen it several times recently in Keokuk County. DuMont (1931) recorded one seen in Polk County, by Andy Harkins, during February, 1923. There are several Iowa specimens.

Centurus carolinus (Linnaeus). Red-bellied Woodpecker

A fairly common resident in the southern half of the state, rare in the northern portion. This species has gradually been extending its range northward and while Anderson (1907) recorded only three straggling occurrences (Allamakee, Winneshiek, and Franklin counties) it now is a resident in small numbers through the entire northern portion of the state. Allert states that it is common in Clayton County, more common in winter than summer, thus suggesting a slight migratory movement.

Melanerpes erythrocephalus (Linnaeus). Red-headed Woodpecker

A common summer resident. Fairly regular and at times a common winter resident in the southern part, less numerous and less frequent in the northern portion. It breeds in all parts of the state.

Asyndesmus lewis Gray. Lewis's Woodpecker

A casual visitor. The only record is of a single individual that remained in Riverside Park, Sioux City, Woodbury County, from November 28, 1928, when it was discovered by Mrs. W. J. Armour, until March 20, 1929. It was seen repeatedly during the intervening time by the members of the Sioux City Bird Club. While the specimen was not collected, there can be no doubt as to the identification (Youngworth, 1931).

Sphyrapicus varius varius (Linnaeus). Yellow-bellied Sapsucker

A fairly common migrant and a rare summer resident, occasionally remaining in winter in the southern portion. Anderson (1907) listed it as a tolerably common summer resident in most parts of the state, especially in the northern parts. Breeding records were given for Poweshiek, Pottawattamie, Mills, Polk, Lee, Linn, and Warren counties. At present it is reported as a rare summer resident in Clayton County (Allert). There is a single recent nesting record in Polk County (Kenneth R. Nelson).

Dryobates villosus villosus (Linnaeus).

Eastern Hairy Woodpecker

A fairly common permanent resident, somewhat more numerous in winter. Breeds throughout the state. Anderson (1907) included *Dryobates v. leucomelas*=*septentrionalis* in his list, on the basis of eight specimens from the Talbot collection, taken at Sioux City in November, 1885, and December, 1884. These were identified by Robert Ridgway, who stated that they were intermediate between *villosus* and *leucomelas*. These birds, along with a series of other Iowa specimens, were recently examined by H. C. Oberholser, who considered them all *villosus*. Measurements of five specimens from Sioux City, Woodbury County, contained in the University of Iowa Museum are as follows:

Museum No.	Date	Sex	Wing	Tail	Exposed culmen
13498	Dec. --, ----	male	122.0	77.5	31.2
13497	Dec. 6, 1884	female	120.6	73.7	29.9
13499	Nov. 13, 1885	----	122.0	81.3	30.5
13496	Dec. 10, ----	female	122.7	78.2	31.2
13500	Dec. 12, ----	female	126.5	77.7	30.9

A typical male and female of *septentrionalis* from Grand Rapids, Manitoba, compare as follows:

Museum No.	Date	Sex	Wing	Tail	Exposed culmen
9361	Feb. 11, 1893	male	134.1	89.7	34.8
9362	Feb. 16, 1893	female	132.8	89.7	33.3

Dryobates pubescens medianus (Swainson).

Northern Downy Woodpecker

A common permanent resident, breeding in all parts of the state.

Picoides arcticus (Swainson). Arctic Three-toed Woodpecker

A casual winter visitor. There are but two records. Anderson (1907) recorded the following report from Walter G. Savage: "About twenty years ago [about 1885] my father shot one, the only record I have in our locality. I have a painting of the bird and was with the man when he shot it. It was taken in the western part of Henry County, on Big Cedar." DuMont (1931) says: "Rare winter visitor. The only record is of one seen February 18, 1924, in Crocker Woods, Des Moines, by Miss Anna K. Bernard and A. T. Watson." Watson

became acquainted with this bird in Maine and the writer accepts his observation as unquestionable. One was seen March 6, 1927, by C. A. Mitchell in the Fontenelle Forest Reserve, south of Omaha, Nebraska, and across the Missouri from Pottawattamie County, Iowa. There are no Iowa specimens.

Order PASSERIFORMES

Family Tyrannidae

Tyrannus tyrannus (Linnaeus). Eastern Kingbird

A common summer resident, breeding in all parts of the state.

Tyrannus verticalis Say. Arkansas Kingbird

A common summer resident in the northwestern corner of the state, gradually spreading east and south. Irregular or rare as a migrant in the eastern portion. Evidence by Anderson (1907) does not indicate when this bird first invaded Iowa as a breeding species, but the following county records suggest the extent of its invasion at the time he wrote: "Dickinson—'One nest found at Spirit Lake, June 15, 1902' (Bingaman). 'Shot one July 30, 1902, at Spirit Lake; two others seen' (Bailey). Sioux—'tolerably common summer resident at Hawarden in 1895' (Berry). . . . Woodbury—'uncommon summer resident. Several were seen and two shot in September, 1903; also August 10 and 16, 1901; May 4, 1902; at Sioux City' (Rich)."

Reported as a common summer resident; breeding at Spirit Lake, Dickinson County (Roberts). Tinker (1914) recorded that it was found in most of the prairie districts throughout Clay and Palo Alto counties. Adults and immature birds of both sexes were secured during August, 1907. Considered as a fairly common summer resident; breeding in Emmet County (Wolden). Bennett (1931) recorded it as a common summer resident in Woodbury County. Gabrielson (1917) recorded it as tolerably common during 1910 and 1911 in Clay, O'Brien, and the surrounding counties. Hendrickson stated that he had seen this bird during the past five or six summers in Winnebago, Hancock, and Kossuth counties. He stated that a Miss Tysseling found a pair nesting recently in Polk County, southwest of Des Moines. Hendrickson believed there could be no doubt as to her identification. Noted as an irregular migrant in Boone County (Rosene). Spurrell observed a single individual at Ames, Story County, May 12, 1916. Hendrickson reported one in the same place May 30, 1933. Recorded as a rare migrant in Polk County and

Clayton County, with four records for the former and five for the latter locality.

Myiarchus crinitus boreus Bangs. Northern Crested Flycatcher

A common summer resident in the wooded areas of the south and east, less numerous in the prairie region of the northwest; breeding throughout the state.

Sayornis phoebe (Latham). Eastern Phoebe

A common summer resident, breeding in all parts of the state. Reported by a few observers as fairly common, or diminishing in numbers.

Sayornis saya saya (Bonaparte). Say's Phoebe

Formerly a casual summer resident. Anderson (1907) recorded one occurrence which seems reliable: "Dr. I. S. Trostler records the species as a rare summer resident in Mills County . . ." There is no Iowa specimen or other satisfactory records.

Empidonax flaviventris (Baird and Baird). Yellow-bellied Flycatcher

An uncommon spring and fall migrant. Several breeding records listed by Anderson (1907) must be considered as errors in identifications as this species does not nest south of the Canadian Zone. In no case was there a record of eggs collected. There are eight specimens in the Philadelphia Academy of Natural Sciences, taken in Mitchell and Winnebago counties during August and September, 1879. Besides these there are several others.

Empidonax virescens (Vieillot). Acadian Flycatcher

An uncommon summer resident in central and southern Iowa, rarely found in the northern portion. Anderson (1907) recorded nesting records for Pottawattamie, Winnebago, and Linn counties, and noted that it was a common summer resident in Blackhawk, Poweshiek, Warren, and Lee counties. He considered it rare in Winnebago County, where a nest with two eggs was taken June 16, 1896.

Allert reported it as a tolerably common summer resident along the Mississippi River at McGregor, Clayton County. Nauman (1926) listed one or two of these birds in Keokuk County each breeding season between 1916 and 1925. DuMont (1931) recorded it as an uncommon summer resident in Polk County, with nesting records in 1929 and 1930. Swenk and Dawson (Wilson Bull., XXXIII, p. 138)

state that at Omaha it is a fairly common summer resident and breeder. Bennett (1931) recorded it as uncommon in the Sioux City region on the basis of observations by A. F. Allen. There is a male in the Dwight collection, American Museum of Natural History, New York City, taken by Walter G. Savage, at Hillsboro, Henry County, May 27, 1895. A female collected by W. A. Willard at Grinnell, Poweshiek County, is in the collection at Grinnell College. The nest and eggs of this bird were placed in the Parker Museum at the college.

Empidonax trailli trailli (Audubon). Alder Flycatcher

A fairly common summer resident, breeding in all parts of the state. The nest of this bird is generally placed in a thick clump of willows. Reported as a fairly common summer resident by Allert in Clayton County and by DuMont (1931) in Polk County. Unreported or considered as rare by a few observers.

Anderson (1907) listed the records for this species under Traill Flycatcher, *Empidonax trailli* (Aud.), and Alder Flycatcher, *E. trailli alnorum* Brewster. In the A. O. U. Check-List, 4th Edition, the latter is considered a synonym of *E. t. trailli*, but the common name Alder Flycatcher is retained.

Empidonax minimus (Baird and Baird). Least Flycatcher

A common migrant, and a summer resident in the extreme northern part of the state. Anderson (1907) recorded it as a common summer resident, and as a nesting bird in Winnebago County. Gabrielson (1917) considered it as a common summer resident in Clay and O'Brien counties. Bennett (1931) recorded it as a common summer resident at Sioux City. A nesting pair was noted by the writer in Polk County. Reported as a migrant only in Clayton, Buchanan, Johnson, and Keokuk counties.

Myiochanes virens (Linnaeus). Eastern Wood Pewee

A common summer resident in all of the woodlands, breeding throughout the state.

Nuttallornis mesoleucus (Lichtenstein). Olive-sided Flycatcher

An uncommon or somewhat rare late spring and fall migrant. Reported as an uncommon migrant in Clayton County (Allert), in the Sioux City region (Bennett and Youngworth) and in Polk County (DuMont). It is considered as rare in Chickasaw County (Spiker),

Buchanan County (Pierce), Johnson County (Roberts), Keokuk County (Nauman), Boone County (Rosene), Marshall County (Gabrielson), and Sac County (Spurrell). There are no breeding records.

The name *Nuttallornis m. majorinus* Bangs and Penard has been proposed for the slightly larger birds breeding from the Rocky Mountains westward. If this race is recognized in the next A. O. U. Check-List these Iowa specimens may be referred to it. A female in the University of Iowa Museum, taken by Ira N. Gabrielson at Marshalltown, Marshall County, May 21, 1913, measures: wing, 102.0; tail, 76.0; exposed culmen, 18.1; tarsus, 15.0. A male in the same collection, secured by R. M. Anderson in Winnebago County, August 28, 1897, measures: wing, 107.0; tail, 79.1; exposed culmen, 16.8; tarsus, 16.3.

Family Alaudidae

Otocoris alpestris hoyti Bishop. Hoyt's Horned Lark

A regular and probably a fairly common winter resident from November to March. It is the opinion of the writer that the bulk of the wintering birds are of this race, *praticola* being absent or nearly so until the middle of February. Field identifications of these poorly differentiated subspecies have been entirely disregarded in this summary. In a large series of Iowa specimens examined by H. C. Oberholser, seven examples of *hoyti* were identified. A male, No. 1222 in the Coe College Museum, was secured by Kubichek at Cedar Rapids, Linn County, February 10, 1929. A number of specimens are in the University of Iowa Museum. No. 28097, a female, was collected at Emmetsburg, Palo Alto County, December 25, 1921. A male, No. 14124, was collected by John Swanson, at Sergeant Bluff, Woodbury County, January 1, 1886. Four other males taken by Swanson were probably from the same locality. They are No. 14108, March 2, 1886; Nos. 14125 and 14121, February 9, 1886; No. 14123 February 19, 1886. A male, secured by Robert Walker at Ogden, Boone County, February 16, 1933 was identified by J. Van Tyne as this subspecies. A male *praticola*, collected at the same time, had testes measuring 4.5 mm., or twice as large as in the male *hoyti*.

Otocoris alpestris alpestris (Linnaeus). Northern Horned Lark

A rare winter visitor. A male, No. 1211 in the Coe College Museum, was collected by Robert Walker at Ogden, Boone County, February 3, 1929. This specimen was recently examined by H. C. Oberholser. Another male, No. 2006 in the same collection, was secured

by W. F. Kubichek in Linn County, January 24, 1930. A juvenile was collected by William Youngworth in Woodbury County, November 16, 1932. The last two specimens were identified by J. Van Tyne.

Otocoris alpestris praticola Henshaw. Prairie Horned Lark

A common summer resident, breeding in all parts of the state. Some few individuals are to be found during the winter, more commonly in the southern portion, thus giving rise to the belief that all are permanent residents. However, only two winter specimens have been examined. A female was secured at Marshalltown, Marshall County, by Ira N. Gabrielson, December 13, 1913, and a female was collected at Emmetsburg, Palo Alto County, December 27, 1921. It is altogether probable that the bulk of the Iowa breeding birds move southward, being replaced by a few *praticola* from the north and principally, in the west at least, by *hoyti*. The return northward is during the first or second week of February.

The Desert Horned Lark, *Otocoris a. leucolaema* (Coues), may occur as a migrant along the western border of the state, but no specimens have been secured.

Family **Hirundinidae**

Iridoprocne bicolor (Vieillot). Tree Swallow

A common migrant, occasionally appearing in flocks of considerable size. This is an uncommon breeding bird in the northern part of the state, and irregularly a nesting bird in the southern half. A nesting record in Muscatine County was reported by Roberts. Nauman stated that it sometimes nested in Keokuk County. DuMont (1931) reported a pair building in Polk County during June, 1928, but the nest was later abandoned.

Riparia riparia riparia (Linnaeus). Bank Swallow

A common summer resident in all parts of the state, breeding wherever there are suitable clay banks for the location of its nests. This species is most numerous in the northern part of the state.

Stelgidopteryx ruficollis serripennis (Audubon). Rough-winged Swallow

A common summer resident, breeding in all parts of the state. This species seems to be equally numerous with the Bank Swallow and somewhat more generally distributed

Hirundo erythrogaster Boddaert. Barn Swallow

A common summer resident, breeding in all parts of the state.

Anderson (1907) summarized the accounts of the early writers who reported this species as rare in Iowa. Nests were placed on the vertical sides of bluffs along the Missouri River. With the advent of the settlers it rapidly increased until now scarcely a farm does not have a nesting pair.

Petrochelidon albifrons albifrons (Rafinesque). Northern Cliff Swallow

A common migrant, and a locally numerous summer resident. Formerly this species was the most numerous swallow. Anderson (1907) said: "With the settlement of the country the species has almost abandoned the cliff-nesting habit, finding the caves of buildings more suitable. This has resulted in a much more general diffusion of the species over the prairie country." Roberts (1932) noticed a diminution of this bird in Minnesota after 1900, and a similar condition existed in Iowa. It has been reported from all parts of the state that breeding colonies have recently increased. The writer witnessed a flight of these birds in Polk County, September 7, 1931. A flock estimated to contain at least three thousand birds was seen.

Progne subis subis (Linnaeus). Purple Martin

A common summer resident throughout the state, breeding wherever houses are provided for its use. Large migratory flocks are frequently seen in the fall.

Family **Corvidae**

Cyanocitta cristata cristata (Linnaeus). Northern Blue Jay

A permanent resident, common in the summer, and less numerous in the winter, breeding in all parts of the state. A partial migration has been noted in the spring and fall with a corresponding decrease of wintering birds, particularly in the northern portion of the state.

Pica pica hudsonia (Sabine). American Magpie

An uncommon migrant and winter resident in the northwest portion of the state, irregular and rare in the eastern part. Anderson (1907) stated that the Magpie was not uncommon in Iowa during the early days. Winter and early spring records, all before 1900, were listed for the following localities: across the Missouri River from Pottawattamie County (Say and Audubon); from Council Bluffs north, along the Missouri River (F. V. Hayden); near Sioux City (Elliot

Coues); a specimen in Winnebago County during the spring of 1875 (John Krider); a specimen caught in a steel trap, in Blackhawk County (Morton E. Peck); one taken in Lee County during the '70's (E. S. Currier); another obtained in Lee County about 1893 (W. E. Praeger); a Nebraska specimen, obtained near Sioux City was measured by Guy C. Rich. He had been told that this bird was not uncommon in that locality years ago.

The only Iowa record between 1893 and 1914 was reported by Spurrell (1919) who said that one was seen in Sac County by C. O. Lee in 1904. Seven birds were seen by Bennett in Woodbury County, within the city limits of Sioux City, October 31, 1914. Subsequent observations by Bennett are four November 11, and three November 25, 1914, and two December 23, 1915, all in Plymouth County, near Sioux City. Stephens (1918) recorded that one was observed a mile east of Morningside, Woodbury County, on February 10, 1918 by Paul Jones. Stephens (1920) stated that the Magpies were more numerous than usual in the Upper Missouri Valley, during the winter of 1919-20. Stephens (1930) recorded that the fall of 1921 brought an unprecedented eastward movement of Magpies across the Missouri River and well into the central part of Iowa. A. J. Anderson, former Sioux City taxidermist, received specimens for mounting from Sioux, Plymouth, Woodbury, O'Brien, and Cass counties. Additional reports were recorded by Stephens from Plymouth, Woodbury, Cherokee, Dickinson, Palo Alto, Pocahontas, Sac, Audubon, Madison, Floyd, and Linn counties. Spiker (1926) stated: "During the past few winters a few of these birds have been found in a deep and thickly timbered ravine in Plymouth County, less than a mile north of the county line, and near the Big Sioux River. On January 24, 1924 I found a small flock of these birds along the Rock River in Sioux County, north of Hawarden." Bennett reported five seen October 26, and twelve, November 2, 1924, north of Stone Park, near Sioux City. Spiker (1926) reported a pair wintering at the same place in 1925-1926. Youngworth (1931) noted that records of this bird were almost lacking between 1926 and 1930. Several were seen near Stone Park, but in Plymouth County, October 31, 1926. Roberts reported that several were seen in Dickinson County during the winters of 1914 and 1921. Wolden found this bird to be a winter resident at Estherville, Emmet County, during the winter 1921-22. DuMont (1931) recorded that during the winter of 1924 George Findley, of Grimes, saw seven of these birds in Polk County. One was collected.

Corvus corax sinuatus Wagler. American Raven

Extinct for many years in Iowa. There is no evidence that the raven ever bred in the state. However, Thomas Say noted it at Engineer Cantonment, with young nearly able to fly, May 12, 1820. Prince Maximilian recorded observations of this bird, probably on Iowa soil, above the Nishnabotna River, May 1, 1833. Audubon, while below the mouth of the Little Sioux River, stated that a fine large Raven passed at one hundred yards. Trippe (1872) said: "A resident of Decatur County who had become familiar with the Raven in the northwest assures me that he had occasionally seen it in this county."

The determination of the subspecific form of Raven which formerly occurred in Iowa is certainly speculation. No specimens have been preserved nor is there any evidence that one was ever collected. The writer has followed the A. O. U. Check-List, 4th Edition, wherein the bird occupying the area from Montana, North Dakota, and Illinois southward is referred to *sinuatus*, the Northern Raven, *Corvus c. principalis* Ridgway, occurring from central Minnesota northward.

Corvus brachyrhynchos brachyrhynchos Brehm. Eastern Crow

A very common permanent resident, breeding in all parts of the state. During the winter months these birds congregate in crow "roosts," which sometimes contain several thousand individuals.

Nucifraga columbiana (Wilson). Clark's Nutcracker

Accidental. This bird of the western mountains has occurred in Iowa upon three occasions, in each instance the record being substantiated by a specimen. No. 10753 in the University of Iowa Museum was shot by Cal Brown four miles south of Boone, Boone County, September 23, 1894. This specimen was donated to the Museum by Carl Fritz Henning (Nutting: Proc. Iowa Acad. Sci., 1894, p. 44). A mounted bird in the same collection was secured by A. W. Hemphill, at Tiffin, Johnson County, November 27, 1919. One in the Smith collection, Odebolt High School, was taken by H. B. Smith in Sac County.

Family **Paridae***Penthestes atricapillus atricapillus* (Linnaeus). Black-capped Chickadee

A common permanent resident, breeding in all parts of the state except perhaps in the region along the Missouri River Valley. It

is possible that systematic collecting would show that *septrionalis* is the breeding form in this area. However, three males in the collection at Morningside College, taken by T. C. Stephens at Sioux City, Woodbury County, are all referable to *atricapillus*. They were taken March 20 and April 15, 1918, and February, 1916. A juvenal female collected by Ruthven in Clay or Palo Alto County, July 14, 1907, was recorded by Tinker (1914) as *septrionalis*. This specimen was recently examined by J. Van Tyne, who stated that he did not consider it *septrionalis*.

Measurements of the wing and tail of several typical specimens of *atricapillus* are as follows:

Seven males			
County	Date	Wing	Tail
Woodbury	February, 1916	68.1	67.8
Woodbury	March 20, 1918	71.9	69.6
Woodbury	April 15, 1918	72.6	66.8
Marshall	January 25, 1914	66.1	64.3
Marshall	April 21, 1914	66.5	65.0
Polk	February 28, 1885	68.6	67.1
Clayton	April 29, 1931	66.5	63.5
Three females			
Clay or Palo Alto	July 14, 1907	65.0	62.0
Polk	April 22, 1885	64.5	64.3
Johnson	---- --, 1887	64.3	62.7

Penthestes atricapillus septrionalis (Harris).

Long-tailed Chickadee

A fairly common winter resident in the northwestern part of the state where it is found to commingle with *atricapillus*. Throughout the central and eastern parts of the state this bird is a rare winter visitor. Exceedingly few breeding specimens from the Missouri River Valley have been examined by the writer but all of these were referable to *atricapillus*. The area of intergradation between these two races undoubtedly is not far west of Iowa, but considerable collecting is needed to determine the exact ranges of the two.

Anderson (1907) listed breeding records from Fremont, Pottawattamie, Mills, Sioux, Mitchell, Winnebago, and Polk counties. The writer entertains considerable doubt in regard to the accuracy of the records in the four counties last named. The lack of agreement in regard to the status of this race is shown by the fact that Roberts (1932) listed no specimens for Minnesota; Over and Thomas (Bull.

9, Series XXI, Univ. South Dakota) recorded this race as a winter resident in the Black Hills of western South Dakota; Swenk (Letter of Information, Nebr. Orni. Union) considers the resident chickadees in eastern Nebraska as referable to this form; Widmann (1907) listed this race for a number of localities in western Missouri.

A male was collected by Anderson at Iowa City, Johnson County, December 30, 1899. DuMont (1931) recorded a specimen taken in Polk County, now in the Schroeder collection, Des Moines. A male in the collection at Morningside College, was taken by A. J. Anderson at Sioux City, Woodbury County, during February, 1916. The wing measures 69.6 and the tail, 69.3. A series of fifteen specimens secured by D. H. Talbot and his collectors at Sioux City during December, 1884 is contained in the University of Iowa Museum. Four of these birds were identified as *septentrionalis* by Robert Ridgway in 1906, and the entire series was recently examined by H. C. Oberholser, who reaffirmed this opinion. Oberholser has pointed out to the writer the importance of distinguishing these birds by coloration as well as by measurements. *Septentrionalis* is slightly larger than *atricapillus*, and has the secondaries and outer webs of the rectrices margined with white, the back and rump is a paler shade of gray. Measurements of the wing and tail of several specimens of *septentrionalis* are as follows:

Six males			
Locality	Date	Wing	Tail
Sioux City, Woodbury Co.	Dec. 8, 1884	69.1	68.1
Sioux City, Woodbury Co.	Dec. 9, 1884	68.6	67.8
Sioux City, Woodbury Co.	Dec. 12, 1884	69.1	65.5
Sioux City, Woodbury Co.	Dec. 8, 1884	68.6	65.5
Sioux City, Woodbury Co.	Dec. 9, 1884	67.6	69.1
Grand Rapids, Manitoba	Dec. 30, 1892	67.6	67.3
Six females			
Sioux City, Woodbury Co.	Dec. 10, 1884	67.3	64.3
Sioux City, Woodbury Co.	Dec. 9, 1884	66.3	64.3
Sioux City, Woodbury Co.	Dec. 9, 1884	66.3	64.3
Sioux City, Woodbury Co.	Dec. 10, 1884	64.3	65.5
Sioux City, Woodbury Co.	Dec. 9, 1884	64.3	65.3
Grand Rapids, Manitoba	Nov. 17, 1892	65.0	65.0

Penthestes carolinensis carolinensis (Audubon). Carolina Chickadee

Accidental. Anderson (1907) recorded that he had examined a specimen taken by George H. Berry, at Keokuk, Lee County, May

4. 1888. This specimen is now in the Museum at Coe College. It measures: wing, 58.9; tail, 49.3; tarsus, 16.0. The identification was recently confirmed by H. C. Oberholser.

Fred J. Pierce reported that a bird of this species was observed by Charles J. Spiker and himself, in Buchanan County, October 7, 1929. The peculiarities of its song were carefully noted. In the experience of the writer the song of this bird is the best clue for its identification.

Baeolophus bicolor (Linnaeus). Tufted Titmouse

A common permanent resident in the southern half of the state, uncommon or fairly rare in the northern portion, breeding throughout its range. In 1907, Anderson recorded this bird as a rather rare resident in southern Iowa, seldom reaching the northern part of the state. Records were listed for Blackhawk, Delaware, and Linn counties, as well as several localities in the south. The northward invasion of this Carolinian species has been one of the conspicuous changes in the bird life of Iowa during the past two decades.

Allert reported this bird as uncommon in Clayton County. Several usually seen each year, but none noted during the summer. Spiker considered it a rare straggler in Chickasaw County. Pierce (1930) recorded it as a fairly common permanent resident in Buchanan County. This bird was first noted at Estherville, Emmet County, in 1919, by Wolden who reports it rare at the present time. Roberts had no observations for Dickinson County. Stephens (1920) reported observations of this bird at Smithland, in southeastern Woodbury County, during the winter of 1919-20 by Ada B. Wendell. It had been reported for several years previously. However, at that time none had been seen at Sioux City. Spiker (1926) recorded it as a rare winter resident in Plymouth County. Youngworth (1931) listed one winter record from Moville, in central Woodbury County, February 12, 1929. Bennett (1931) listed it as uncommon in the Sioux City region. In the southern part of the state, DuMont (1931) has summarized the number of these birds present in the winter as recorded on the Bird-Lore Christmas Census at Des Moines. The minimum number seen during the past decade was 53 in 1924, and the maximum, 132 in 1928. To properly evaluate these figures it must be noted that twice as many observers participated in the census of 1928 as did on the earlier occasion.

Family Sittidae

Sitta carolinensis carolinensis Latham. White-breasted Nuthatch

A common permanent resident, breeding in all parts of the state. Several observers have noted that it is either more numerous or more conspicuous during the winter months.

Sitta canadensis Linnaeus. Red-breasted Nuthatch

An uncommon and somewhat irregular migrant, infrequently found as a winter resident during January and February. The fall and spring migration period may actually be periods of residence. Birds are noted as early as August 30 (Winnebago County), and irregularly thereafter until the end of December. There are a few records of birds seen throughout the winter but most frequently they reappear in March and are then noted until the second week in May (Woodbury, Floyd, Buchanan, Marshall, and Scott counties).

Family Certhiidae

Certhia familiaris americana Bonaparte. Brown Creeper

A common migrant, and a fairly common winter resident. Anderson (1907) recorded the only authentic breeding record for Iowa. A nest containing three newly-hatched young was found by Burtis R. Wilson, on an island in the Mississippi River five miles below Davenport, Scott County, May 10, 1891. Both birds were seen to visit the nest with food for the young. Other summer occurrences and possible nesting records were listed for Polk, Pottawattamie, Mills, and Woodbury counties.

In recent years this species has either been overlooked as a summer resident or it has retired northward. Roberts (1932) noted it as a breeder only in the pine forests of northern Minnesota. The only recent Iowa report is by Fenton (1923-24) who noted it during June, July, and August in six localities in Floyd County, once in Cerro Gordo County, and near Waverly, in Bremer County, during June of 1918 and August of 1917. No evidence of nesting was obtained.

Family Troglodytidae

Troglodytes aëdon parkmani Audubon. Western House Wren

A very common summer resident, breeding in all parts of the state. Several observers in the southern and eastern portions reported it as abundant. There is no evidence that the Eastern House

Wren, *Troglodytes a. aedon* Vieillot, occurs in Iowa. Specimens from the eastern half of the state were examined by J. T. Zimmer and H. C. Oberholser, who determined them all as *parkmani*.

Nannus hiemalis hiemalis (Vieillot). Eastern Winter Wren

A fairly common migrant in the eastern half of the state, uncommon or somewhat rare in the western half, and a fairly rare winter resident. Allert reported it as a common migrant in Clayton County, with one winter record. Spiker considered it as a fairly common migrant in Chickasaw County. Pierce (1930) recorded it as a rather scarce migrant in Buchanan County. Ellis reported seeing a few in Jackson County. Nauman regarded it as very rare in Keokuk County. Gabrielson (1919) stated that this bird was a tolerably common migrant in Marshall County. DuMont (1931) recorded it as a fairly common migrant and an uncommon winter resident in Polk County. Hendrickson has observed it as a winter resident several times in Story County. Rosene considered it rare in Boone County. Wolden reported it as rare in Emmet County. Both Bennett (1931) and Youngworth have found this bird to be an uncommon migrant in the Sioux City region.

Thryomanes bewicki bewicki (Audubon). Bewick's Wren

An uncommon summer resident in the extreme southeastern corner of the state, a fairly rare and irregular summer resident in the central and extreme eastern part of the state, along the Mississippi River. Breeding records have been reported from the central and southern parts. Anderson (1907) listed it as rare and very locally distributed. A specimen was taken by Paul Bartsch at Burlington, Des Moines County, April 10, 1893, and two nests were found May 25, 1892 and May 30, 1893. Giddings reported it as a rare migrant in Jackson County; one seen April 6, 1890, one the next day, and several on April 8, 1890. W. E. Praeger reported it as a scarce summer resident, breeding in Lee County. E. S. Currier considered it an uncommon summer resident in the same locality. W. G. Savage reported it as a tolerably common summer resident in Van Buren County. Melvin P. Somes stated that a specimen had been taken in Webster County.

Miss Althea R. Sherman has seven records of this bird at National, Clayton County. Allert collected a male, April 12, 1933 in the same county. A pair nesting in a bird box at Iowa City, Johnson County,

raised a brood of four young during May, 1933 (DuMont). H. E. Jaques reported one seen at Mt. Pleasant, Henry County, April 28, 1933. W. G. Ross found this bird at Fairfield, Jefferson County, before 1907. A male in the Dwight collection, American Museum of Natural History, was taken by W. G. Savage at Hillsboro, Henry County, April 19, 1895. One was seen by Spiker (1924) in Wapello County, May 6, 1913. Nauman reported nine observations during late March or early April between 1919 and 1929. His only fall observation was October 29, 1925. DuMont (1931) recorded this bird as a fairly rare migrant, a rare summer resident, and breeder. Noted April 26, 1925 and September 24, 1924, by A. T. Watson. A single breeding record was obtained during June, 1931. The nest was placed in a mailbox and later rebuilt in another. Of the seven eggs laid only one hatched before the nest was deserted (J. E. Stewart and Olivia McCabe). Rosene has one record for Boone County.

Thryothorus ludovicianus ludovicianus (Latham). Carolina Wren

An uncommon and irregular resident in the southern half of the state, very few records in the northern half. Recorded as a breeder only in the southern part of Iowa. Anderson (1907) classed this bird as very rare and local. Thomas Say reported it at Engineer Cantonment in 1819-20, and it was listed by J. A. Allen in 1870. Records were given by Anderson for Webster, Linn, Van Buren, and Lee counties.

Pierce (1930) recorded an observation of this bird in Buchanan County, April 20, 1923. A specimen in the museum of Iowa Wesleyan College was secured at Burlington, Des Moines County, September 2, 1886. A male in the Dwight collection, American Museum of Natural History, was taken by W. G. Savage at Hillsboro, Henry County, May 1, 1900. Stephens (1917) recorded a specimen captured by G. O. Ludcke, at Sioux City, Woodbury County, early in October, 1916. It was identified by Ludcke and A. F. Allen and then released. Stephens (1918) recorded another which was seen by Allen and himself, February 27, 1918, in the same locality. It remained until March 21. DuMont (1931) recorded this as an uncommon and irregular resident in Polk County. A summary of numerous observations at Des Moines indicated that this bird was more numerous or more frequently seen during the winter months than in the summer. Mrs. Toni Wendelburg recorded (Bulletin,

Iowa Orni. Union, VII, pp. 14 and 17) that a pair resided in her garden at Des Moines for two years, nesting during 1928 and 1929.

Telmatodytes palustris dissaëptus (Bangs). Prairie Marsh Wren

A fairly common migrant, a fairly common summer resident in the north-central and northwestern parts of the state, uncommon or rare in the southern and eastern portions, breeding throughout its range. In 1907 Anderson recorded this bird as a common summer resident in all parts of the state where suitable sloughs and marshes were found, being even abundant in some localities. As a result of the extensive draining of such marshes this bird has become considerably reduced in numbers. In 1932, F. L. R. Roberts reported it abundant in the sloughs about Spirit Lake, Dickinson County, ten years ago, nesting in some numbers. During the last eight years no nests have been found.

Cistothorus stellaris (Naumann). Short-billed Marsh Wren

An uncommon migrant and a rare summer resident in the southern half of the state, fairly common in the northern part. Allert reported it as a common migrant, rather irregular as to nesting; some years it was common, during others, entirely absent. Spiker considered it rare in summer in Chickasaw County. Fenton (1923-24) recorded it as a tolerably common migrant and rare summer resident in Floyd County. Pierce (1930) recorded it as a fairly common but local summer resident in Buchanan County. Wolden reported it as fairly common in Emmet County. Gabrielson (1917) recorded a colony at Webb, Clay County. Spurrell (1921) considered this bird a common migrant and a common breeder in suitable localities in Sac County. Youngworth reported it as an uncommon breeder in Woodbury County, and Bennett (1931) recorded it as a tolerably common migrant in the same locality. All observers in the southern part of the state reported it as a rare or local breeder.

Salpinctes obsoletus obsoletus (Say). Common Rock Wren

A casual summer resident along the western border of the state. Anderson (1907) stated that it was first recorded from Iowa by T. Martin Trippe who took a specimen in October, and saw several others, in Decatur County. Trippe recorded: "It was seen on several occasions, far out on the prairie, running over the ties on the railroad track, retreating, when alarmed, into the dense prairie grass" (Am. Nat., 1873, p. 566).

Guy C. Rich wrote Anderson from Sioux City as follows: "The Rock Wrens were here and bred for two or three years, but I have not seen them now for several years. A nest of eggs was discovered on June 25, 1898, badly incubated. On May 28, 1899, the two birds were again seen. On June 1, 1899, I saw two and possibly three birds. They sing a great deal. Found no nest, though. I thought them to be breeding. On June 10, 1900, the birds were discovered in another deep dirt-cut along railroad; no nest found. On September 15, 1901, had a bird brought in from another locality. I have also seen the measurements of two birds shot June 22, 1898." Rich wrote Bennett that the nest at Sioux City was found June 25, 1898 by Stanley Hills at the side of the big cut on the Riverside car track. The nest and eggs were deposited in the museum of the Sioux City Academy of Science.

A single bird was observed by Walter W. Bennett and A. W. Lindsey at Stone Park, in Woodbury County, April 1, 1910. The bird was observed under ideal conditions, at one time not more than 6 feet distant. A complete description of the plumage and song was made at the time of observation (Wilson Bull., XXXVII, p. 93). Miss Althea R. Sherman observed one of these wrens at National, Clayton County, September 27, 1914. It was watched for some time through 8-power glasses from a distance of 30 feet. A complete description was written while observing the bird (Auk, XXXII, p. 234). There are no Iowa specimens.

Family Mimidae

Mimus polyglottos polyglottos (Linnaeus). Eastern Mockingbird

An uncommon and irregular summer resident in the southern third of the state. Wandering individuals have been reported from all parts of Iowa during the summer months; occasionally present in winter. Anderson (1907) stated that it was a rare but regular summer resident in the southern part of Iowa and that there were a number of records of its occurrence in the central, and even in the northern, part. A nesting record was listed for Sioux County. Guy C. Rich reported that a bird had been seen in several localities in Sioux City, Woodbury County, between May 30 and June 1, 1902, and that one had been observed the previous year. Keyes and Williams (1889) reported a specimen taken at Charles City, Floyd County. Peck and Walters both noted it in Blackhawk County. One was seen in Marshall County, September 3, 1894. H. W. Parker recorded three

observations in Poweshiek and Jasper counties. Johnson stated that he had mounted one or two which had been killed near Des Moines, Polk County. Jeffrey reported a nesting record in Warren County, May 8 to 20, 1898. It was noted in the summer in Wayne County, and one was seen in Van Buren County during 1894. Cooke (1888) listed two winter records at Burlington, Des Moines County. Several observers found this bird to be a scarce summer resident, breeding in Lee County.

It has been reported recently as breeding in several localities. Several pairs have nested four miles northeast of Maquoketa, Jackson County, since 1914 (Ellis). A. W. Lindsey found a nesting pair in Sioux City, Woodbury County, during the summer of 1911 or 1912 (Bennett). A pair nesting south of Valley Junction, Polk County, during June, 1929, was seen by several observers (DuMont, 1931). It was reported as nesting for three years, 1928 to 1930, six miles southwest of Stanton, Montgomery County (C. E. Hoskinson). A pair was reported nesting at Martinsburg in 1914, and another pair at South English, during the summer of 1926. Both localities are in Keokuk County. During July, 1929, a pair was found nesting seven miles west of Sigourney, in the same county, by J. B. Slate (Nauman). A pair breeding at Mt. Pleasant, Henry County, during 1925, was found by Pete Parks and H. E. Jaques.

There are a number of observations during the summer months. Observed in Woodbury County during April, 1925 by Charles J. Spiker and Mrs. Marie Dales. Another seen by the latter October 3, 1926. Mrs. Maud L. Moser reported two occurrences at Dallas Center, Dallas County. In Polk County it was seen during June, 1922 by K. R. Nelson; during April, 1925, by A. T. Watson; seven birds seen in four different localities during 1929; a pair remained for five weeks during May and June, 1932 (DuMont). One was seen at Grinnell, Poweshiek County, during April, 1929 by Wayne Gard, Mrs. W. H. Mack, and Donald Douglas. Nauman reported observations in Keokuk County during 1927 and 1929, and one by J. B. Slate during April, 1928. Spiker (1924) recorded two occurrences in Wapello County, one during 1911 and the other in June, 1923. It was reported seen at Fairfield, Jefferson County, by W. G. Ross. Miss Althea R. Sherman observed one at National, Clayton County, August 16, 1931. One was seen at Vinton, Benton County, by Walter L. Burk in 1930. One was noted at Cedar Rapids, Linn County, May 9, 1931 by A. J. Palas and W. F. Kubichek.

There are two winter records. One visited several feeding trays in west Des Moines, Polk County, during February, 1932. Walter Rosene reported one during December, 1932 and January, 1933 at Ogden, Boone County. It remained five weeks. No Iowa specimens have been found by the writer.

Dumetella carolinensis (Linnaeus). Catbird

A common summer resident, breeding in all parts of the state. Anderson (1907) listed two winter records. Recently one was noted at Des Moines, Polk County, visiting a feeding table during December, 1923. One was noted at Rock Rapids, Lyon County, during December, 1931. A slightly crippled individual was seen at a feeding board at Iowa City, Johnson County, throughout December, 1931. In 1932 another, apparently uninjured, frequented the same board during that month.

Toxostoma rufum (Linnaeus). Brown Thrasher

A common summer resident, breeding throughout the state. It is occasionally found in winter. DuMont (1931) recorded that individuals were seen in Polk County during December of 1928, 1929, and one remained through the winter of 1929-30. One was seen there December 26, 1932. One was seen by Mrs. S. Anderson at Ogden, Boone County, December 13, 1930. O. S. Thomas recorded (Iowa Bird Life, II, pp. 25-26) that one spent most of the winter of 1931-32 at Rock Rapids, Lyon County.

Family **Turdidae**

Turdus migratorius migratorius Linnaeus. Eastern Robin

An abundant summer resident, breeding in all parts of Iowa. It is an uncommon but regular winter resident in the southern half of the state, somewhat rare and irregular in the northern portion.

Hylocichla mustelina (Gmelin). Wood Thrush

A common summer resident in all wooded areas of the state, most numerous along the larger rivers, less numerous in the north-central part of the state. Wolden reported it a rare summer resident in Emmet County, and Roberts noted it only as a migrant in Dickinson County.

Hylocichla guttata faxoni Bangs and Penard. Eastern Hermit Thrush

A fairly common migrant in the eastern part of the state and un-

common in the western portion. There are several typical examples.

It is certain that some form of *Hylocichla guttata* other than *faxoni* occurs as a migrant in Iowa. Two specimens in the Dwight collection, American Museum of Natural History, identified by the late J. Dwight as *sequoiensis*, were taken by Walter G. Savage at Hillsboro, Henry County. No. 12858, a male, secured April 7, 1897, measures as follows: wing, 93.7; tail, 69.8; exposed culmen, 16.0; tarsus, 29.8. It appears to be typical of *sequoiensis*. No. 12857, a female, taken April 20, 1895, measures as follows: wing, 94.0; tail, 73.5; exposed culmen, 14.7; tarsus, 30.8. It is identical in coloration with No. 12858 and, except for the slightly short wing, might be referred to *auduboni*. Concerning these two specimens J. T. Zimmer wrote as follows: "Certainly they match *sequoiensis* best, but geographically should not belong to that form. They should be *auduboni*, if not *faxoni*, and they are decidedly paler than the latter form. They are smaller than the measurements given by Ridgway for *auduboni*, but agree with some other western specimens probably belonging to the same form."

There are two other gray-flanked Iowa specimens with wings measuring over 99.0. Both are in the University of Iowa Museum. One was taken by Anderson at Forest City, Winnebago County, April 6, 1897; the other was taken by Rosene at Ogden, Boone County, April 17, 1928. They probably are *auduboni*. However, until a revisionary study of *Hylocichla guttata* is made, it seems advisable to leave these Iowa specimens unnamed.

Hylocichla ustulata ustulata (Nuttall). Russet-backed Thrush

Accidental. There is but one record of this Pacific coast species in Iowa. There is a male, No. 26745, in the Dwight collection, American Museum of Natural History, collected at Keokuk, Lee County, May 20, 1907. This bird was formerly in the C. K. Worthen collection (DuMont: Wilson Bull., XLI, p. 252).

Hylocichla ustulata swainsoni (Tschudi). Olive-backed Thrush

A fairly common migrant, slightly more numerous in the eastern part of the state. Normally it appears in numbers about equal with the Gray-cheeked Thrush, although this proportion varies from season to season.

Hylocichla minima aliciae (Baird). Gray-cheeked Thrush

A fairly common migrant. Allert reported it a common migrant

in Clayton County. Spiker considered it rare in Chickasaw County. It was reported as a common migrant in Johnson County by Roberts. Nauman reported it as rare in Keokuk County. It was reported as fairly common in Wapello, Polk, Story, and Boone counties. Wolden noted it as a common migrant in Emmet County, and both Bennett and Youngworth reported it common in Woodbury County.

Hylocichla fuscescens salicicola Ridgway. Willow Thrush

A fairly common migrant in the eastern part of the state, uncommon or somewhat rare in the western portion. A few observers considered it as rare. Formerly it nested rarely as far south as central Iowa. Allen (1868) recorded it as being very common in western Iowa during July, 1867. Trippe (1872) had no records of it in Decatur and Mahaska counties. Keyes and Williams (1889) stated that several nests had been taken at Des Moines, Polk County. Bingaman found one nest in Kossuth County during May, 1903. Anderson (1907) recorded it as a summer resident in Winnebago County; he found no nests. He stated that Carl Kelsey noted it as a fairly common summer resident in Poweshiek County. There are no recent breeding records in Iowa.

A series of six specimens from eastern Iowa was examined by J. Van Tyne. He determined them all as *salicicola*. A male in the Coe College Museum, taken August 2, 1902, appears to be as dark as typical *fuscescens*, but it is too dirty to be satisfactorily identified. J. T. Zimmer wrote that a male in the Dwight collection, American Museum of Natural History, taken by Walter G. Savage at Hillsboro, Henry County, May 1, 1895, is equivocal, but not clearly separable from *fuscescens*. Both Oberholser and Van Tyne believe that all Iowa birds belong to the form *salicicola*.

Sialia sialis sialis (Linnaeus). Eastern Bluebird

A common summer resident, breeding in all parts of the state. A few are found irregularly in winter in southern Iowa. Pierce (1930) recorded this bird as a scarce summer resident. Both Bennett and Youngworth considered it a common resident in the Sioux City region with numerous winter records. DuMont (1931) recorded it as an abundant summer resident in Polk County and stated that none had been seen during December or January. However, a pair was seen there December 26, 1932.

Family Sylviidae

Poliophtila caerulea caerulea (Linnaeus). Blue-gray Gnatcatcher

A fairly common summer resident in the southern part of the state and along the Mississippi River, uncommon in the central portion, rarely found in the upper Missouri River Valley. Anderson (1907) stated that it was a common summer resident in the southern part of Iowa, occurring regularly in the central part of the state, very seldom reaching northern Iowa. He listed reports from Pottawattamie, Decatur, Warren, Polk, Poweshiek, Mahaska, Blackhawk, Delaware, Linn, Johnson, Scott, Muscatine, Henry, Van Buren, and Lee counties.

Allert stated that it was a common summer resident along the Mississippi bluffs in Clayton County. They were found breeding in several parts of the county. Spiker reported it as rare in Chickasaw County. Pierce (1930) recorded observations during May in 1923 and 1928 in Buchanan County, and stated that Mrs. Bordner found it nesting in Devil's Backbone State Park, Delaware County, in 1923. Hendrickson noted a pair in the same locality during June, 1924. On May 17, 1932, Pierce found a nest of this bird in Delaware County. Nauman reported it as a breeding bird in Keokuk County. DuMont (1931) recorded it as an uncommon migrant in Polk County. Mrs. J. E. Stewart found a pair nesting there in 1930. The writer observed this species in the Ledges State Park, Boone County, each summer between 1918 and 1920. Bennett (1931) recorded it as rare in the Sioux City region. He cited observations by T. C. Stephens and Mrs. H. M. Bailey. Margaret L. Weir recorded (Wilson Bull., XLIII, p. 230) seeing this bird at Hawarden, Sioux County, during the summers of 1929 and '30. A nest was found during June, 1931. There are several specimens.

Regulus satrapa satrapa Lichtenstein.

Eastern Golden-crowned Kinglet

A common migrant in all parts of the state, a moderately common winter resident in the southern half, irregular and somewhat rare in the northern part.

Corthylio calendula calendula (Linnaeus).

Eastern Ruby-crowned Kinglet

A common migrant throughout the state, infrequently found dur-

ing the winter in the extreme southern part. This bird appears to be more common than *Regulus satrapa*.

Family Motacillidae

Anthus spinoletta rubescens (Tunstall). American Pipit

An uncommon and irregular migrant. Anderson (1907) recorded it as a tolerably common migrant and listed records from Woodbury, Greene, Polk, Decatur, Hancock, Blackhawk, Mahaska, and Lee counties.

Allert reported it as a fairly common migrant in Clayton County. Spiker considered it a common migrant in Chickasaw County. Fenton (1923-24) recorded one observation in Floyd County, April 17, 1917. Pierce (1930) recorded six observations of birds seen in plowed fields, Buchanan County. A flock of eight was seen by the writer at Fairfield, Jefferson County, May 6, 1933. Rosene observed it once in Boone County. Wolden reported it as a former migrant in Emmet County, but that none had been seen for a number of years. Youngworth stated that it was rather uncommon as a migrant in Woodbury County, and Bennett (1931) recorded it as a tolerably common migrant. There are several specimens.

Anthus spraguei (Audubon). Sprague's Pipit

The present status is undetermined. Anderson (1907) stated that the only Iowa record was that of I. S. Trostler, who reported it as a straggler in Pottawattamie County; one killed near Manawa Lake, September 14, 1895. The writer has been unable to learn what became of this specimen. There are no further records.

Roberts (1932) listed this as a common summer resident in the Red River Valley region of northwestern Minnesota. Before the breaking up of the prairie it was a nesting bird in the southwestern part of that state. It is possible that migrants of this species through the Missouri River Valley have been confused with the American Pipit. A series of skins is needed.

Family Bombycillidae

Bombycilla garrula pallidiceps Reichenow. Bohemian Waxwing

An uncommon winter visitor in the northern part of the state, somewhat rare and irregular in the southern part. The erratic wandering of this bird appears to be governed by the presence or absence of berries or other fruits (Stephens, 1920). Anderson (1907)

noted this bird November 24, 1894 in Winnebago County. The bulk of them are seen between December and March. However, Stephens (1920) recorded small flocks seen throughout April and as late as May 4, 1920 in Woodbury County. From twenty to a hundred birds are normally aggregated in these flocks. Miss Althea R. Sherman has recorded (Auk, XXXVIII, pp. 278-279) an account of the invasion of these birds into Iowa during the winter of 1908-09. A flock in Clayton County seen by Jerome Jones and Mrs. D. A. Wright was estimated to have contained thousands of these birds. A. J. Palas observed a flock at Des Moines, March 18, 1923 which contained between five and six thousand individuals (DuMont, 1931). There are numerous specimens.

Bombycilla cedrorum Vieillot. Cedar Waxwing

A common but irregular migrant, and a fairly common winter resident, most numerous in the southern part of the state; a few remain irregularly to breed. Wandering flocks may appear during any month of the year but are most frequently seen during the cherry season. Anderson (1907) listed breeding records from several parts of the state, and it has recently been reported as nesting in Clayton, Keokuk, Polk, Boone, and Woodbury counties.

Family **Laniidae**

Lanius borealis borealis Vieillot. Northern Shrike

A rare winter visitor. Most of the wintering birds of this species are referable to the western subspecies *invictus*. One example, in a series of twelve Iowa specimens examined by Alden H. Miller of the University of California, was determined as typical *borealis*. It is a female, No. 12712 in the Dwight collection, American Museum of Natural History, secured by Walter G. Savage at Hillsboro, Henry County, December 8, 1898. Three specimens were determined by Miller as intergrades between *borealis* and *invictus*. These are: No. 12710, a female in the Dwight collection, taken by Savage at Hillsboro, February 18, 1897; No. 17836, in the University of Iowa Museum, secured by Lawrence Martin at Sioux City, Woodbury County, November 25, 1885; a female in the J. Eugene Law collection, taken at Perry, Dallas County, January 3, 1895.

Lanius borealis invictus Grinnell. Northwestern Shrike

A fairly common winter resident in all parts of the state. Of twelve specimens examined by Miller (see above), one was determined

as *borealis*, three as *borealis-invictus* intergrades, and eight as typical of *invictus*. Miller wrote: "The large shrikes seem to tend more to the *invictus* type than toward *borealis*. None are of the extreme large size of *invictus*, but two or three of the five adults are very typical *invictus* as regards coloration." Five so determined were taken by Walter G. Savage at Hillsboro, Henry County, and are now in the Dwight collection, American Museum of Natural History. They are: No. 12707, a male, secured January 6, 1896; No. 12706, a male, February 19 1895; No. 12708, a female, January 13, 1896; No. 12713, a male, January 4, 1900; No. 12711, a male, March 1, 1897. Three are in the D. H. Talbot collection, University of Iowa Museum. These are: No. 17840, secured at Little Sioux, Harrison County, December 3, 1884; No. 17835, a male, taken at Sioux City, Woodbury County, December 8, 1884; No. 17838, a male, taken at the same place, January 3, 1884.

Lanius ludovicianus migrans Palmer. Migrant Shrike

A fairly common summer resident, breeding in all parts of the state. It was reported as common by a number of observers. A series of seven specimens was submitted to Alden H. Miller of the University of California for examination. All were determined as *migrans*. Included in this series was a male taken in Woodbury County during April, a female from Sioux County in September, a male from Marshall County in April, a male from Linn County in March, and three males from Clayton County taken during April and May. One of the latter, taken at Giard, May 13, 1932, was determined as *migrans* with characters slightly approaching *excubitorides*.

Anderson (1907) listed both *excubitorides* and *migrans*, stating, however, that he believed most of the Iowa records should be referred to the latter form. The writer has found no evidence for including the White-rumped Shrike in the Iowa list. Certainly straggling individuals must come into the western part of the state during migration, but at present no substantiating specimens are to be found.

Family Sturnidae

Sturnus vulgaris vulgaris Linnaeus. Starling

Following its introduction in New York City during 1890 this bird increased rapidly along the Atlantic coast, and about 1916 it crossed the Alleghany Mountains.

The first record in Iowa was of a single bird that was caught and shown to W. S. Long at Lamoni, Decatur County, during December, 1922. No more were seen until 1928 when a few were noted by Kubichek during March in Johnson County. During 1929 it was reported in Polk, Chickasaw, and Johnson counties. The invasion became widespread in 1931 and 1932.

At the present time (1933) it is a fairly numerous breeding bird in the eastern half of the state, and an uncommon winter resident. About one hundred and twenty reports of the Starling have been received, mostly from the eastern third of the state. An irregular line marking the distribution westwardly would extend through the following counties: Floyd, Bremer, Blackhawk, Tama, Story, Boone, Dallas, Polk, Marion, Mahaska, Keokuk, Jefferson, and Van Buren. There are reports of Starlings in all counties east of this line, and besides the 1922 Decatur County record there are reports from Union County (1932), Monona County (1932), Calhoun County (1933), and Ida County (1933). This bird may be expected in increasing numbers in all parts of the state.

Family Vireonidae

Vireo griseus griseus (Boddaert). White-eyed Vireo

A decidedly uncommon summer resident in the southern third of the state, and a rare straggler in the northern part. The writer has learned of no recent breeding records. Anderson (1907) recorded it as a tolerably common summer resident in southern Iowa and rather rare or irregular in the central part of the state. A summary of the county records listed by him is as follows: one collected in Woodbury County, April 18, 1900 (Rich); Walters reported it as a rare nesting species in Blackhawk County; Giddings reported it as a common summer resident in Jackson County; Berry stated it was a common summer resident in Linn County; W. A. Bryan reported it quite common in Story County; Henning classed it as fairly common in Boone County; Trostler reported it as a common summer resident in Pottawattamie County. The reporters from the southern counties more or less agreed that this bird was a summer resident.

The writer is unable to account for the utter lack of recent records. One was identified by Roberts at Spirit Lake, Dickinson County, May 18, 1923. DuMont (1931) recorded it as an uncommon migrant in Polk County. Migration dates ranging from April 23, 1924 (Wendelburg) to May 22, 1928 (Watson) were listed for

the spring, and for the fall, from August 29, 1926 (Watson) to September 13, 1925 (Watson). There are reports of this bird in Jefferson County before 1907 (W. G. Ross). It was reported from Omaha May 15, 1926 (Letter of Information of the Nebr. Orni. Union). There are several specimens taken before 1900.

Vireo belli belli Audubon. Bell's Vireo

A fairly common summer resident in the southern and western parts of the state, somewhat rare in the northeastern portion, breeding throughout its range. Anderson (1907) listed this bird as a common or abundant summer resident. Allert and Pierce did not report it from Clayton and Buchanan counties. Spiker considered it a rare summer resident in Chickasaw County. DuMont (1931) recorded it as a fairly common summer resident in Polk County. Bennett (1931) stated that it was common in summer in the Sioux City region.

Vireo flavifrons Vieillot. Yellow-throated Vireo

A fairly common migrant, and a somewhat rare summer resident, breeding in small numbers throughout the state. It has recently been reported as a summer resident in the following counties: Clayton, uncommon (Allert); Chickasaw, common (Spiker); Buchanan, occasional (Pierce); Keokuk, rare breeder (Nauman); Polk, rare (DuMont); Story, rare (Hendrickson).

Vireo solitarius solitarius (Wilson). Blue-headed Vireo

A fairly common migrant in all parts of the state. Reported by a few observers as a common migrant, and by others as rare.

Vireo olivaceus (Linnaeus). Red-eyed Vireo

A very common migrant, and a common summer resident, breeding in all portions of the state.

Vireo philadelphicus (Cassin). Philadelphia Vireo

An uncommon migrant. Anderson (1907) stated that it must have been rare in Iowa or else was overlooked, owing to its close resemblance to the Warbling Vireo. Specimens were listed from Winnebago, Woodbury, and Johnson counties.

Roberts considered this bird a fairly common migrant in Johnson County. DuMont (1931) recorded it as a fairly common migrant in Polk County. Eleven observations in the spring range from

April 28 to May 20. Nine fall records are from September 2 to October 8.

There are four specimens in the Keyes collection, Iowa State College, Ames, that were secured in Polk County during 1885 and 1886. One in the University of Iowa Museum was also taken in Polk County during May, 1885. Two others in the same collection were secured in Marshall County during September, 1914. Another, a female, was taken August 31, 1901, at Forest City, Winnebago County. A female was collected at Iowa City, Johnson County, May 20, 1904. One in the Coe College Museum was collected during May, 1913, probably in Linn County. Two females in the Allert collection were secured at Giard, Clayton County, May 18, 1928 and October 1, 1927.

Vireo gilvus gilvus (Vieillot). Eastern Warbling Vireo

A common summer resident, breeding throughout the state.

Family **Compsothlypidae**

Mniotilta varia (Linnaeus). Black and White Warbler

A common migrant in all parts of the state. Anderson (1907) listed it as a breeding bird in Blackhawk, Linn, Van Buren, and Lee counties. It was noted as well during the summer in Winneshiek, Franklin, Woodbury, Polk, Henry, and Scott counties. Youngworth noted young birds at Sioux City, Woodbury County, August 11, 1929 and concluded that they were reared in the vicinity. However, no nests have been found within recent years in Iowa.

Protonotaria citrea (Boddaert). Prothonotary Warbler

A fairly common summer resident along the wooded streams and river-bottoms in southern Iowa. This Carolinian form has continued to increase slightly in numbers, and it has slowly been extending its range northward along the larger rivers. Anderson (1907) said that it about reached its northern limit on the Iowa River in Johnson County, on the Cedar River in Blackhawk County, and on the Des Moines River in Webster County. Trostler reported it as a common summer resident in Mills County. Guy C. Rich considered it rare at Sioux City, Woodbury County. Bailey collected two males in Allamakee County in 1904.

Youngworth reported it as a breeding bird in the Sioux City region. A specimen was collected west of that city, in South Dakota, May 11, 1929. Roberts observed it at Spirit Lake, Dickinson County,

May 17, 1928. Hendrickson considered it rare in Story County. DuMont (1931) listed four observations in Polk County. A specimen in the museum of Iowa State Teachers College was collected at Cedar Falls, Blackhawk County, in 1925. Pierce (1930) recorded one observation in Buchanan County. Allert reported it as a common summer resident along the Mississippi River bottoms in Clayton County. There are numerous observations from southeastern Iowa, as well as several specimens.

Helmitheros vermivorus (Gmelin). Worm-eating Warbler

A fairly rare summer resident in extreme southern Iowa. Anderson (1907) recorded it as breeding in Henry, Van Buren, and Kosuth counties. Concerning the latter record, which is from the northern edge of the state, he says: "Nest with five badly incubated eggs taken June 4, 1904, in quite heavy timber on slightly sloping hillside; male taken (Bingaman)." It was noted as a migrant in Linn and Lee counties. Chapman (Warblers of North America, 1907, p. 49) states that it has been taken at Des Moines, Polk County, and on May 15, 1886, at Grinnell, Poweshiek County.

DuMont (1931) listed it as a rare migrant in Polk County with the following observations: one observed May 25, 1915 (McCabe); one seen in the woods at Camp Dodge, September 10, 1925 (Palas); one noted September 13, 1930 (Wendelburg). Nauman reported six observations in Keokuk County, ranging from April 27 to May 15. Spiker (1924) recorded one in Wapello County, May 25, 1913. There are three specimens in the Dwight collection, American Museum of Natural History, secured by Walter G. Savage at Hillsboro, Henry County: two males taken May 4, 1895 and May 17, 1898; a female collected May 20, 1898. W. E. Praeger has a specimen which he collected at Keokuk, Lee County, May 19, 1889. No recent breeding records have been reported.

Vermivora chrysoptera (Linnaeus). Golden-winged Warbler

A fairly rare migrant in the eastern half of the state, unreported from the western part. Anderson (1907) listed it as a migrant in several eastern counties. Bingaman reported two nests taken in Grundy County during June, 1898.

Gabrielson (1919) recorded it as a rare migrant in Marshall County, two specimens were collected. DuMont (1931) classed it as an uncommon migrant in Polk County, six observations having been listed

for May and one for September. It was reported as a rare migrant in Boone County (Rosene), Story (Hendrickson and Roberts), Keokuk (Nauman), and Buchanan (Pierce) counties. There are a number of specimens. There are no recent reports of breeding.

Vermivora pinus (Linnaeus). Blue-winged Warbler

An uncommon migrant in the eastern half of the state, very rare in the western part. Reported as a fairly rare summer resident in central Iowa, more numerous eastwardly. Roberts (1932) states that it has slowly extended its range northward into Minnesota, being restricted to the Mississippi River bottoms. Anderson (1907) listed only one record from the northern part of the state, a nest found at Decorah, Winneshiek County, in June, 1895, by C. C. Smith. It was recorded as a summer resident in the southeastern part of the state. Reports of breeding were somewhat variable. Trostler considered it a common migrant and a scarce summer resident in Pottawattamie County.

Allert reported it as a fairly common summer resident in Clayton County. Spiker noted it as rare in summer in Chickasaw County. Pierce (1930) recorded it as a common migrant and a summer resident. Hendrickson found it to be a rare summer resident in Story County. Rosene reported it as a rare breeder in Boone County. DuMont (1931) recorded it as a fairly rare summer resident in Polk County. Spurrell (1921) stated that three were seen by Mrs. George May in Sac County during the spring of 1912.

Vermivora peregrina (Wilson). Tennessee Warbler

A common migrant in all portions of the state. It appears to vary somewhat in numbers, being abundant during some seasons and at others, only fairly common.

Vermivora celata celata (Say). Orange-crowned Warbler

A fairly common migrant throughout the state. No doubt it is frequently overlooked because of its somber colors. There are a number of specimens.

Vermivora ruficapilla ruficapilla (Wilson). Nashville Warbler

A fairly common migrant, somewhat rare in the northwestern part of the state. Although several observers reported it as rare, in the experience of the writer, this bird is one of the commonest migrant warblers in central and eastern Iowa.

Compsothlypis americana pusilla (Wilson). Northern Parula Warbler

An uncommon migrant in the eastern part of the state, somewhat rare in the western part. Reported by a number of observers as a rare migrant. There are no breeding reports. Several specimens have been secured.

Dendroica aestiva aestiva (Gmelin). Eastern Yellow Warbler

An abundant summer resident, breeding in all parts of the state.

Dendroica magnolia (Wilson). Magnolia Warbler

A common migrant in the eastern part of the state, uncommon and somewhat irregular in the western half.

Dendroica tigrina (Gmelin). Cape May Warbler

A fairly rare migrant. In the '80's this bird was considered very rare west of the Mississippi River. Anderson (1907) listed records from Winneshiek, Blackhawk, Jackson, Linn, Johnson, Poweshiek, Scott, Van Buren, and Lee counties.

The following county reports were received: Clayton, uncommon migrant (Allert); Chickasaw, rare migrant (Spiker); Buchanan, irregular migrant (Pierce); Keokuk, extremely rare, only two in twenty years (Nauman); Polk, fairly rare migrant, three recent records (DuMont); Story, rare migrant (Hendrickson); Boone, irregular migrant (Rosene); Sac, rare migrant (Spurrell); Dickinson, one seen May 13, 1933 (Bennett), rare migrant (Roberts); Emmet, irregular migrant (Wolden); Woodbury, not common (Youngworth); uncommon migrant (Bennett). There are several specimens. Chapman (Warblers of North America, 1907, p. 129) listed one taken at Iowa City, Johnson County, November 27.

Dendroica caerulescens caerulescens (Gmelin).

Black-throated Blue Warbler

A fairly rare migrant in the eastern part of the state, unreported from the western part. Anderson (1907) recorded it as a rare migrant in Winnebago, Webster, Blackhawk, Linn, Jackson, Scott, Poweshiek, Mahaska, and Van Buren counties. He listed a male which he collected in Winnebago County, May 14, 1892.

Allert reported it as an uncommon migrant in Clayton County. Miss Althea R. Sherman has several observations of this bird at National in the same county. A male in her collection was picked

up dead, May 27, 1909. Pierce (1930) recorded one occurrence in Buchanan County. Nauman considered it a very rare migrant in Keokuk County. DuMont (1931) listed it as a fairly rare migrant in Polk County. It was noted from May 17 to 31, and September 25 to 30. Hendrickson reported it a rare migrant in Story County. Fenton (1923-24) recorded it as a rare migrant in Floyd and Mitchell counties. A male in the Coe College Museum was collected by O. M. Greenwood in Delaware County, May 16, 1914. Three specimens in the Philadelphia Academy of Natural Sciences were collected by W. L. Abbott in Mitchell County, September 6, 7, and 8, 1879.

Dendroica coronata (Linnaeus). Myrtle Warbler

A very common migrant in all parts of the state. Reported by most observers as the most abundant warbler.

Dendroica virens virens (Gmelin). Black-throated Green Warbler

A fairly common migrant in the eastern part of the state, uncommon in the western portion. A few observers consider it a rare migrant. It is reported as common in Clayton County (Allert), and in Polk County (DuMont).

Dendroica cerulea (Wilson). Cerulean Warbler

An uncommon summer resident in south-central and eastern Iowa, rare in the western part. It has been noted most frequently during the period of migration. However, as the northward limit of its breeding range is in southeastern Minnesota, it is altogether probable that these birds are present in Iowa during the summer months but overlooked due to their shyness.

Allert noted it as a tolerably common migrant and rare summer resident in Clayton County. Hendrickson reported a pair seen in Delaware County during May, 1924. Pierce (1930) has one observation for Buchanan County, and a record of four birds in Delaware County during May, 1931. DuMont (1931) listed it as an uncommon migrant in Polk County; there are a number of observations. The writer has frequently found this bird in the Ledges State Park, Boone County, where it is a regular summer resident and a few breed. Rosene has found it regularly in Boone County. This is the same locality in which J. A. Allen found it quite common in 1868. Spurrell (1921) stated that there was one specimen in the H. B. Smith collection taken in Sac County. Wolden furnished the

most northerly record in Iowa. He observed one during August in Emmet County. A male taken by A. J. Anderson at Sioux City, May 20, 1899, is now in the Pettigrew Museum, Sioux Falls, South Dakota. Mrs. J. A. Dales observed this bird once at Sioux City. There are several specimens from southern and eastern Iowa.

Dendroica fusca (Müller). Blackburnian Warbler

A regular spring and fall migrant in the eastern half of the state, rare in the western part. Reports of abundance from eastern Iowa vary considerably. Allert noted it as a common migrant in Clayton County. Pierce (1930) listed it as a regular migrant in Buchanan County. Gabrielson (1919) recorded it as a tolerably common spring migrant in Marshall County. DuMont (1931) stated that it was a fairly common migrant in Polk County. All other observers in eastern Iowa reported it as rare. Wolden considered it a rare migrant in Emmet County. Bennett (1931) recorded it as an uncommon migrant in the Sioux City region. Youngworth reported it as very rare in the same area.

Dendroica dominica albilora Ridgway. Sycamore Warbler

Probably a fairly rare summer resident in the extreme southern part of the state. According to the A. O. U. Check-List, 4th Edition, this species breeds from southeastern Nebraska, southern Wisconsin, southern Michigan, southward. While there are several observations of this bird in Iowa all except two have been made during May. Spiker (1924) saw one near Ottumwa, Wapello County, August 28, 1913. DuMont (1931) recorded one seen by A. T. Watson at Des Moines, Polk County, August 29, 1926. Another observation by Watson at Des Moines was May 29, 1927. Roberts noted one at Iowa City, Johnson County, May 17 1931. The record of several observations has been furnished from the files of the U. S. Biological Survey. These include observations at Sigourney, Keokuk County, by Nauman on the following occasions: May 18 to 26, 1917; May 16 to 18, 1920; May 22, 1921; May 21 to 23, 1922; May 23 and 24, 1924; May 20, 1927. Spurrell (1921) recorded an observation by Mrs. George May at Wall Lake, Sac County, May 13, 1913. It is difficult to know whether this may be considered as a straggling record or the misidentification of another species, probably the Blackburnian Warbler.

Anderson (1907) described in detail a specimen secured by George

H. Berry at Keokuk, Lee County, May 4, 1888. This specimen was formerly in the Coe College Museum.

Dendroica pensylvanica (Linnaeus). Chestnut-sided Warbler

A fairly common migrant in the eastern part of the state, uncommon and somewhat irregular as a migrant in the western part. Anderson (1907) recorded it as an abundant migrant in all parts of the state, breeding in many localities, but rather locally distributed. It was listed as breeding in Kossuth, Blackhawk, Tama, Linn, Jackson, Poweshiek, Mahaska, Van Buren, Lee, and Pottawattamie counties, and as a summer resident in Franklin and Henry counties.

It has recently been reported as a common migrant in Clayton County (Allert), Chickasaw County (Spiker), and Polk County (DuMont). It has been noted as a rare migrant in Story County (Hendrickson), and in Boone County (Rosene). Stephens reported seeing one or two each season at Sioux City, Woodbury County.

Since 1900 this bird has entirely disappeared from Iowa as a breeding species. Roberts (1932) has noted a similar condition in the southern part of Minnesota. However, he believes a careful search through the second-growth and cut-over areas would reveal this warbler as a scarce breeder south to the Iowa line.

Dendroica castanea (Wilson). Bay-breasted Warbler

A somewhat rare migrant in eastern Iowa. There are very few records from the western part. Anderson (1907) listed it as a rather rare migrant in eastern Iowa; once observed at Spencer, Clay County. It was recorded from Winneshiek, Blackhawk, Jackson, Scott, Johnson, Poweshiek, Van Buren, and Lee counties.

Allert reported it as an uncommon migrant in Clayton County. DuMont (1931) recorded it as an uncommon migrant in Polk County. All other observers reporting from the eastern part of the state considered it rare. Tinker (1914) recorded that a single adult male was collected by Alexander G. Ruthven in a grove in Clay County, July 4, 1907. T. C. Stephens recorded (Wilson Bull., XXV, p. 202) the following observations from Sioux City, Woodbury County, during 1913: "The only previous record of mine is June 4, 1910 on the College campus. This year Miss Pearl Woodford told me of seeing one at Sergeant Bluff on May 10. On the 14th Mr. Arthur Lindsey saw two on the campus; on the 15th I saw one; and on the 18th one was reported to me by Paul Chipperfield." There are several specimens.

Dendroica striata (Forster). Black-poll Warbler

A common migrant in all parts of Iowa. The report of a pair breeding in Dallas County, May 20, 1894, must be considered as a misidentification. Although the female was collected the male was not seen.

Dendroica pinus pinus (Wilson). Northern Pine Warbler

A migrant in irregular numbers throughout the state. Anderson (1907) said that because this warbler is rarely found outside of pine woods it is very locally distributed in Iowa, although it frequently appeared in considerable numbers during migration. Several specimens were listed.

It was not reported from Clayton County. Spiker considered it a rare migrant in Chickasaw County. Pierce (1930) recorded it as a very irregular and scarce migrant in Buchanan County. Nauman noted it in Keokuk County during May, from 1926 to 1929. DuMont (1931) listed it as a rare migrant in Polk County. Rosene reported it as rare in Boone County. Wolden noted it as a rare migrant in Emmet County. Bennett (1931) recorded it as an uncommon migrant in the Sioux City region; he noted a pair at Arnold's Park, Dickinson County, May 13, 1933. H. C. Oberholser wrote that the files of the U. S. Biological Survey contained many migration records from Iowa. There are three specimens in the Dwight collection, American Museum of Natural History, secured by Walter G. Savage at Hillsboro, Henry County: a male and a female taken April 25, 1897, and a male April 24, 1900.

Dendroica discolor discolor (Vieillot). Northern Prairie Warbler

A rare straggler from the south. Anderson (1907) recorded a single observation by Morton E. Peck, who spent several hours trying to collect one of these birds in Linn County in 1896.

DuMont (1931) listed four observations for Polk County: it was seen by Kenneth R. Nelson on May 14, 1923 and May 1, 1927; one was noted by Olivia McCabe, May 28, 1915; one was noted by Toni Wendelburg, September 13, 1930. The files of the U. S. Biological Survey contained a record of observations by a Mr. Mosher of West Liberty, Muscatine County. He noted a single bird September 29 and 30, 1922. There are no Iowa specimens. Evidence of breeding is entirely unsatisfactory.

Dendroica palmarum palmarum (Gmelin). Western Palm Warbler

It is noted in Iowa only as a migrant. Anderson (1907) listed it as a common spring and fall migrant in the eastern and central portions of the state. No observations from the western part of the state were recorded.

Reports from the various counties are as follows: Clayton, common migrant (Allert); Chickasaw, fairly common (Spiker); Floyd, uncommon migrant (Fenton); Buchanan, an abundant migrant (Pierce); Keokuk, common migrant, sometimes rare (Nauman); Wapello, fairly common migrant (Spiker); Polk, very common spring migrant, not common in the fall (DuMont); Marshall, a common spring migrant (Gabrielson); Story, rare migrant (Hendrickson); Boone, rare migrant (Rosene); Sac, rare migrant (Spurrell); Emmet, common migrant (Wolden); Dickinson, common migrant (Roberts); Woodbury, tolerably common migrant (Bennett). Youngworth noted it as a spring and fall migrant in the same locality, not especially common or regular. In the experience of the writer this bird has been found as a common migrant in central Iowa, arriving with great regularity on April 26. There are many specimens.

Seiurus aurocapillus (Linnaeus). Oven-bird

A common migrant in the eastern part of the state, fairly common in the western portion. It is a summer resident in all parts of Iowa, breeding commonly in the heavily wooded sections of the south and east, uncommon in the central area, and rare or absent in the northwest. Both Bennett and Youngworth reported it as a rare breeder in Woodbury County. Wolden has noted it as a frequent summer resident in Emmet County.

Seiurus noveboracensis noveboracensis (Gmelin).

Northern Water-Thrush

A casual migrant along the Mississippi River Valley. The writer recorded (Auk, XLVII, pp. 91-93) two specimens in the Dwight collection, American Museum of Natural History. No. 12787, a male, was secured by Walter G. Savage at Hillsboro, Henry County, May 29, 1897. The exposed culmen measured 11.0 mm., bill from nostril, 9.1 mm. No. 26465, a female, was formerly in the C. K. Worthen collection and was taken at Keokuk, Lee County, May 12, 1904. Exposed culmen, 11 mm., bill from nostril, 9.7 mm. Because of the very slight differences in size and coloration between this

subspecies and the next all sight records of *S. noveboracensis* in Iowa should be referred to Grinnell's Water-Thrush.

Seiurus noveboracensis notabilis Ridgway. Grinnell's Water-Thrush

A fairly common migrant in all parts of the state. It is reported as a common migrant by several observers in the eastern part of the state, and from the Sioux City region. During May, 1933 the writer found this bird to be an abundant migrant along the Iowa River in Johnson County.

Several records of breeding noted by Keyes and Williams (1889) and Anderson (1907) must be considered as misidentifications of *Seiurus motacilla*. The southern breeding limit of Grinnell's Water-Thrush is considerably to the north. A series of eleven Iowa specimens of *notabilis* was examined, including five from Clayton County. This confirms the general opinion that this form is the one noted most frequently as a migrant through Iowa.

Seiurus motacilla (Vieillot). Louisiana Water-Thrush

An uncommon summer resident in the southern and eastern part of the state, most numerous as a breeding bird along the Mississippi River bottoms. Anderson (1907) stated that it was found in most parts of Iowa, breeding sparingly throughout its range, but that it was generally rare north of the middle of the state. It was listed as a breeding bird in Kossuth, Winneshiek, Linn, Mahaska, Decatur, and Lee counties. It was noted as a summer resident in Blackhawk, Poweshiek, Van Buren, and Pottawattamie counties. ~

Rosene reported this bird as common in Boone County, where he recently found it breeding. Allert stated that it has been found as a summer resident in Clayton County. Spurrell (1921) recorded only one observation in Sac County. It has been reported from Woodbury County as a common migrant, by Bennett (1931), as a regular migrant every spring, by Youngworth (Wilson Bull., XLIII, p. 65), and Stephens recorded (*ibid* XXV, p. 202) that it seemed to be the more common of the two Water-Thrushes. These observations may denote an extension of range of this Carolinian form, northward along the Missouri River Valley. However, there are no South Dakota records as yet, and it is reported only in southeastern Minnesota.

Oporornis formosus (Wilson). Kentucky Warbler

A rare summer resident in southern and eastern Iowa. Anderson

(1907) listed several records. Peck took a specimen at LaPorte City, Blackhawk County. A female was collected at West Liberty, Muscatine County, by E. H. King on May 1, 188(1?). It is now in the Coe College Museum. Giddings reported that it was rather rare; a few bred each season in Jackson County. A male now in his collection was taken at Sabula. One was secured at Burlington, Des Moines County, May 11, 1884 by F. Knitham and C. J. Reed. W. G. Savage reported it as a common summer resident in Van Buren County. It was noted as a common summer resident in Lee County by Praeger and Currier.

Leroy Titus Weeks observed three birds at McGregor, Clayton County, August 8, 1923. On August 16, 1923 he collected one at the same place but it was not preserved (notes from U. S. Biological Survey). A male was observed by the writer at Iowa City, Johnson County, May 22, 1933. A specimen in the Davenport Public Museum was taken in Scott County by W. L. Allen. Two males in the Dwight collection, American Museum of Natural History, were secured by Walter G. Savage at Hillsboro, Henry County, May 16 and 27, 1900. Spiker (1924) recorded that one was seen near Ottumwa, Wapello County, July 31, 1914. DuMont (1931) recorded it as a rare straggler in Polk County, where it was noted May 17, and September 13, 1925 by A. T. Watson; on May 21, 1927 one was seen by Watson and Kenneth R. Nelson. A straggling record from northwestern Iowa is of an adult male secured by Otto W. Remer at LeMars, Plymouth County. This bird was captured alive about April 28, 1916, and it was mounted by A. J. Anderson, former Sioux City taxidermist. This specimen remains in Remer's collection and it was recently examined by the writer. There have been no recent reports of breeding.

Oporornis agilis (Wilson). Connecticut Warbler

An uncommon or somewhat rare migrant, reported only from the eastern half of the state; less frequently noted in the fall. Anderson (1907) recorded specimens collected in Winnebago, Hancock, Linn, and Van Buren counties.

Allert reports it as an uncommon migrant in Clayton County. Miss Althea R. Sherman has three specimens in her collection which were picked up dead at National, in the same county, May 27, 1909. This bird is reported as a rare migrant in the following counties: Chickasaw (Spiker); Floyd (Fenton); Buchanan (Pierce); Keokuk

(Nauman); Story (Hendrickson); and Boone (Rosene). DuMont (1931) records it as a fairly common migrant in Polk County, noted in the spring from May 5 to 31, and in the fall from August 29 to October 1. There is a specimen in the Dwight collection, American Museum of Natural History, secured by Walter G. Savage at Hillsboro, Henry County, May 13, 1895. A male and a female in the museum of Iowa State Teachers College were taken by Harry Fields at Cedar Falls, Blackhawk County. Three specimens are in the University of Iowa Museum: a male, May 22, 1897 in Hancock County, and a female, May 20, 1904 at Forest City, Winnebago County, were both taken by Rudolph M. Anderson; a female was collected by Ira N. Gabrielson at Marshalltown, Marshall County, August 22, 1914.

Oporornis philadelphia (Wilson). Mourning Warbler

An uncommon and irregular migrant throughout the state, slightly more numerous in the eastern part. It was reported as rare by several observers. DuMont (1931) classed it as a fairly common migrant in Polk County. Gabrielson (1919) recorded it as a tolerably common migrant in Marshall County. Spiker (1924) listed it as a common migrant in Wapello County. Youngworth recorded (Wilson Bull., XLIII, p. 65) seeing forty-five of these birds in a walk of two or three miles at Sioux City, Woodbury County, May 22, 1930. There are several specimens.

Geothlypis trichas brachidactyla (Swainson).

Northern Yellow-throat

A common summer resident, breeding in all parts of the state.

Icteria virens virens (Linnaeus). Yellow-breasted Chat

A fairly rare summer resident in southern Iowa, and fairly common along the Missouri River Valley, north at least to the mouth of the Big Sioux River, breeding throughout its range. This bird was formerly much more numerous. Anderson (1907) stated that it was a common summer resident as far north as the center of the state, abundant in the southeastern part, and rather rare in most localities in northern Iowa. It was recorded as formerly common in Blackhawk and Des Moines counties, but became scarce due to the close pasturing of the woods. W. H. Bingaman reported it as a common summer resident, nesting in Kossuth County. Guy C. Rich con-

sidered it as an uncommon summer resident in Woodbury County. A specimen was listed, taken by J. E. Law in Cerro Gordo County, May 30, 1891.

Allert reported several early observations by Miss Althea R. Sherman in Clayton County, but none seen recently. Fenton (1923-24) recorded seeing two birds in Floyd County, May 20, 1918. Nauman considered it a rare summer resident, nesting in Keokuk County. Spiker (1924) had several reports of this bird in Wapello County. DuMont (1931) listed a single recent observation for Polk County. Lester P. Fagen noted it as a breeding bird in that locality in 1909. Hendrickson noted it as a straggler in Story County. Rosene reported it as rare in Boone County. Bennett (1931) recorded it as a tolerably common summer resident in the Sioux City region. There are several early specimens. In a letter to Thomas S. Roberts, May 29, 1933, Howard F. Graesing of Spirit Lake, Dickinson County, reported finding a dead Chat two days before.

Wilsonia citrina (Boddaert). Hooded Warbler

Formerly a rare summer resident in southern Iowa, breeding in the extreme southeastern corner. There are no specimens or recent observations. Anderson (1907) stated that the most northerly record west of the Mississippi River was of one seen by Morton E. Peck at LaPorte City, Blackhawk County. One was collected by Paul Bartsch at Burlington, Des Moines County, May 25, 1892. H. J. Giddings reported seeing one in Jackson County, June 1, 1897. Trippe (1872) recorded taking one in Mahaska County. Lynds Jones reported one collected in Poweshiek County, May 18, 1888. W. E. Praeger noted it as a summer resident, breeding in Lee County. Edmonde C. Currier stated that it nested commonly at Keokuk, Lee County, frequenting the damp bottom-land along the Mississippi and Des Moines rivers.

Wilsonia pusilla pusilla (Wilson). Wilson's Warbler

A fairly common migrant in all parts of the state, somewhat irregular in occurrence in the western part. This bird was reported as a common migrant in Clayton County (Allert), Marshall County (Gabrielson, 1919), Polk County (DuMont, 1931), and in Keokuk County (Nauman).

Wilsonia canadensis (Linnaeus). Canada Warbler

A fairly common migrant in eastern and central Iowa, and appar-

ently rare in the western part. Anderson (1907) stated that Thomas Say noted this species at Engineer Cantonment in 1819-20.

It was listed as a common migrant in Clayton County (Allert), and in Polk County (DuMont, 1931). Pierce (1930) recorded it as a regular migrant in very small numbers in Buchanan County. Gabrielson (1919) recorded it as an uncommon spring migrant. All others, who observed it in eastern Iowa, listed it as rare. Roberts reported one observation of it in Dickinson County. Bennett (1931) recorded it as a tolerably common migrant in the Sioux City region; Stephens and Youngworth did not list it from this area.

Setophaga ruticilla (Linnaeus). American Redstart

An abundant migrant, and a common summer resident, breeding throughout the state. It is less numerous in the northwest part. Wolden reported it as a rare summer resident in Emmet County. Roberts noted it only as a migrant in Dickinson County. Bennett (1931) listed it as a common summer resident in the Sioux City area; Youngworth classed it as an uncommon summer resident in the same area.

Family Ploceidae

Passer domesticus domesticus (Linnaeus). English Sparrow

An abundant permanent resident, breeding in all parts of the state. This obnoxious alien was introduced into this country at New York during 1850. Its westward invasion was supplemented in Iowa by a number of local plantings. It first appeared at Burlington in 1869-70 where it may have been introduced. Ten pairs, either from Europe or from an established colony in this country, were planted at Davenport in 1870. At Cedar Rapids they were introduced from Massachusetts about 1874. Twenty pairs were planted at Dubuque in 1876. It was introduced at Sioux City in 1882.

During recent years these birds appear to be increasing somewhat in the open country, feeding in the grain fields, and nesting about the farm buildings. The invasion of the starling has as yet had no effect in reducing the number of "House Sparrows" in this area.

Family Icteridae

Dolichonyx oryzivorus (Linnaeus). Bobolink

A fairly common migrant throughout the state, a common breeding bird in the northern part, uncommon and irregularly distributed in the southern portion. These birds were considerably reduced in num-

bers due to the breaking up of practically all the original prairie. At present they appear to be increasing somewhat, particularly in northeastern Iowa.

Sturnella magna magna (Linnaeus). Eastern Meadowlark

A common summer resident, most numerous in the southern and eastern part of the state, uncommon in the northwestern portion. It is found regularly during the winter in southern Iowa. It is no longer possible to establish a line of demarcation between the Eastern and the Western Meadowlarks as their ranges have so broadly overlapped that both are present in most counties in the state. The louder song of the Western Meadowlark is generally a sufficiently diagnostic character for differentiating between these two.

Sturnella neglecta Audubon. Western Meadowlark

A common summer resident in the western and northern half of the state, less frequently noted in southeastern Iowa. It has been increasing in numbers in the northeastern part of the state. Allert reported them present in numbers about equal with those of the Eastern Meadowlark in Clayton County. Pierce (1930) considered *magna* slightly more numerous than *neglecta* in Buchanan County and northward. It has been noted regularly as a winter resident in southern Iowa, less frequently northward.

A series of sixty-nine skins from Woodbury County (part of the Talbot series of over seven hundred *neglecta*) contained in the University of Iowa Museum, are all typical *neglecta*, showing no intermediate characters.

Xanthocephalus xanthocephalus (Bonaparte). Yellow-headed Blackbird

A common summer resident in northern and western Iowa, breeding from the central part of the state westward. It occurs as a common migrant in western Iowa, somewhat rare in the extreme eastern part. However, Spiker reported it as a common migrant in Chickasaw County. It has recently been noted as a local breeder in Polk, Story, and Hamilton counties (DuMont). Records of former breeding are extant from Marshall, Floyd, and Buchanan counties. Breeding colonies of considerable size may be found in northwestern Iowa wherever there are sloughs and marshes with a luxuriant growth of quill-reeds (*Phragmites*), and containing water throughout the summer.

Agelaius phoeniceus phoeniceus (Linnaeus). Eastern Red-wing

A very local breeder in extreme eastern Iowa, probably confined to the flood-plain of the Mississippi River. It is an uncommon migrant in the eastern part of the state, occasionally straggling into the central part. No specimens have been secured during the winter.

Two breeding males from Clayton County taken May 13, measure as follows:

County	Wing	Exposed Culmen	Height at base	Tarsus	Tail
Clayton	117.0	22.1	11.4	28.3	85.0
Clayton	119.0	22.2	11.3	28.0	85.0

Three breeding females taken in Clayton County May 13 and 14, and one in Johnson County May 13, measure as follows:

County	Wing	Exposed Culmen	Height at base	Tarsus	Tail
Clayton	102.0	19.9	10.0	25.5	74.0
Clayton	102.0	18.0	10.0	25.5	73.5
Clayton	101.6	19.0	10.3	26.1	76.0
Johnson	102.5	18.5	bill open	25.6	74.2

There are specimens of *phoeniceus* taken during the migratory period from Allamakee, Clayton, Johnson, Marshall, and Story counties. The range of measurements of five males is: wing, 116.3 to 121.0; exposed culmen, 21.4 to 22.4; height of culmen at base, 11.0 to 11.9; tarsus, 27.3 to 30.5; tail, 83.4 to 90.1. The range of measurements of four females is: wing, 97.8 to 102.0; culmen, 17.8 to 19.0; height of culmen at base, 9.8 to 10.4; tarsus, 25.0 to 26.5; tail, 69.0 to 74.0. All specimens were identified by H. C. Oberholser.

Agelaius phoeniceus arctolegus Oberholser. Giant Red-wing

An abundant summer resident, breeding in all parts of the state except the extreme eastern portion, where it is replaced by *phoeniceus*. It is an abundant migrant in all parts of the state. Some form of Red-wing winters irregularly in southern Iowa and occasionally in the northern part. Specimens are not available to determine whether these birds are *arctolegus* or *fortis*. The latter is a common early spring and late fall migrant throughout the state.

Measurements of twelve breeding male *arctolegus* are as follows:

County	Wing	Exposed Culmen	Height at base	Tarsus	Tail
Woodbury	125.3	23.0	11.2	30.2	92.0
Cerro Gordo	124.0	22.8	13.0	28.8	91.2
Dallas	125.5	23.2	11.0	27.9	90.2
Dallas	122.0	23.8	11.5	29.0	93.0
Dallas	121.0	22.8	11.9	28.0	90.0
Dallas	124.8	22.8	12.0	29.0	95.5
Tama	125.5	22.4	12.2	29.0	95.2
Johnson	122.0	22.8	11.0	29.9	89.0
Johnson	124.0	23.0	12.6	32.2	91.0
Johnson	122.0	22.7	13.0	31.2	88.0
Johnson	123.0	23.4	12.5	32.0	90.0
Van Buren	126.0	24.6	13.0	31.4	91.8

Measurements of six breeding female *arctolegus* are as follows:

County	Wing	Exposed Culmen	Height at base	Tarsus	Tail
Woodbury	moulting	19.0	10.5	27.0	moulting
Dallas	103.5	19.0	10.0	25.7	75.0
Tama	106.0	19.1	10.1	28.0	79.0
Tama	102.0	20.0	bill open	28.1	75.0
Tama	104.0	19.0	bill open	27.0	79.0
Johnson	102.2	19.6	10.7	27.0	74.5

Specimens taken during May, 1933, in Johnson County, appear to be nearly intermediate in size, and in the coloration of females, between *phoeniceus* and *arctolegus*, but slightly nearer the latter form.

The range of measurements of fifteen male *arctolegus* taken in all parts of the state at other than the breeding season is as follows: wing, 120.5 to 126.0; exposed culmen, 21.4 to 24.3; height of culmen at base, 11.0 to 12.4; tarsus, 26.9 to 31.4; tail, 87.1 to 94.5. All of these specimens were identified by H. C. Oberholser.

Agelaius phoeniceus fortis Ridgway. Thick-billed Red-wing

A common early spring and late fall migrant in all parts of the state, most numerous in the western portion. A study of wintering specimens probably would reveal this subspecies to be the one most frequently found. There is no evidence of its breeding in Iowa, nor any area containing forms intermediate between it and *arctolegus*.

There are twenty-one males and four females taken in Woodbury, Monona, Winnebago, Story, Polk, Clayton, Linn, Iowa, and Johnson counties, between October 6 and April 12. The range of measure-

ments of the sixteen adult males is as follows: wing, 127.0 to 130.4; exposed culmen, 22.0 to 23.7; height of culmen at base, 11.0 to 13.1; tarsus, 28.2 to 31.8; tail, 90.0 to 97.9. The range of measurements of four females is as follows: wing, 102.0 to 106.5; exposed culmen, 19.0 to 22.0; height of culmen at base, 11.0 to 11.1; tarsus, 25.0 to 28.9; tail, 73.7 to 79.0. All specimens were identified by H. C. Oberholser.

Icterus spurius (Linnaeus). Orchard Oriole

An uncommon summer resident in the western half of the state, fairly rare and irregularly distributed in the northern and eastern parts, breeding throughout its range. It is reported as a common summer resident in the Sioux City region.

There has been a noticeable decrease of this species since 1907 when Anderson recorded it as a common summer resident in all parts of Iowa. It is the opinion of the writer that the grackle has been instrumental in driving it out.

Icterus galbula (Linnaeus). Baltimore Oriole

A common summer resident, breeding in all parts of the state.

Euphagus carolinus (Müller). Rusty Blackbird

A common migrant in all parts of the state, occasionally wintering, in small flocks, in the southern part. There are no breeding records.

Euphagus cyanocephalus (Wagler). Brewer's Blackbird

An uncommon migrant, most numerous in the western part of the state. Bennett (1931) recorded it as an uncommon migrant in the Sioux City region. Spurrell (1919) recorded it as a fairly common migrant in Sac County; they frequently were noted as they followed within a few feet of the plow; observations ranged from March 15 to April 28. The following records were supplied from the files of the U. S. Biological Survey: Stephens noted it in Woodbury County, May 19, 1913 and April 4, 1914; Spurrell reported it as a regular spring and fall migrant at Wall Lake, Sac County; Nauman reported it regularly in the spring and fall migration, noting flocks of as many as 500. One catalogued in the U. S. National Museum was secured at Sioux City, Woodbury County, May 13, 1864. DuMont (1931) recorded it as an uncommon migrant in Polk County; migration dates in the spring ranged from March 15 to April 26. A flock of twenty-five was seen by Henry Birkeland at Nevada, Story County, April 20, 1933. The dark iris of the female and the violet

reflections on the head and neck of the male were noted. Roberts had seven records for Johnson County.

This bird has gradually been extending its range eastward, and Roberts (1932) has recorded it as a common summer resident in Minnesota, breeding in colonies throughout most of that state. It may be expected as a breeding bird in northern Iowa.

Quiscalus quiscula acneus Ridgway. Bronzed Grackle

An abundant migrant and a very common summer resident, breeding in all parts of the state. It is occasionally found in winter. Toward evening in the late summer or fall, flocks of several thousand grackles may be seen on their way to a selected grove or "roost." These flocks frequently contain many red-wings, cowbirds, and a few starlings.

Molothrus ater ater (Boddaert). Eastern Cowbird

A very common summer resident, breeding in all parts of the state except, possibly, the northwestern corner. The only breeding specimen available from that area proved to be *Molothrus a. artemisiae*. Additional breeding specimens from the western part of the state are needed to determine the ranges of these two races.

The range of measurements of twenty-four male *ater* taken in Clayton, Linn, Johnson, Iowa, Poweshiek, Marshall, Story, and Polk counties, between April 11 and June 3, is as follows: wing, 103.0 to 114.0; exposed culmen, 15.6 to 18.0; height of culmen at base, 9.8 to 11.1; tarsus, 25.8 to 28.0; tail, 71.8 to 82.6.

Molothrus ater artemisiae Grinnell. Nevada Cowbird

An uncommon migrant in all parts of Iowa. An examination of additional breeding specimens from the western part of the state may establish this western subspecies as the breeding form in that area. A male, No. 18158 in the University of Iowa Museum, was secured by Will Wight, one of Talbot's collectors, at Sioux City, Woodbury County, June 24, 1884. It is typical of *artemisiae*. Measurements of seven males are as follows:

County	Date	Wing	Culmen	Height at base	Tarsus	Tail
Woodbury	June 24, 1884	115.2	18.6	10.9	28.0	77.0
Linn	May 16, 1927	115.0	18.4	11.2	27.6	81.5
Johnson	May 23, 1894	116.0	18.2	11.2	28.1	73.2
Johnson	May 1, 1890	116.0	17.4	10.6	27.2	78.3
Johnson	May 12, 1890	117.0	18.0	11.2	27.1	81.2
Johnson	May 1, 1929	116.0	18.4	10.4	27.7	81.8
Polk	May 5, 1884	116.5	17.9	10.6	27.9	77.0

This subspecies has not previously been reported from Iowa. These specimens were identified by H. C. Oberholser.

Family *Thraupidae*

Piranga erythromelas Vieillot. Scarlet Tanager

A summer resident, breeding throughout the state. Most numerous in the heavily wooded areas of the south and east, and along the Missouri River in the west. Most of the observers reported it as fairly common, a few considered it as rare.

Piranga rubra rubra (Linnaeus). Summer Tanager

Formerly a fairly rare summer resident in the southern part of the state, a few records of breeding. Anderson (1907) listed the record of Keyes and Williams who stated that during the season of 1889 it was seen at Des Moines, Polk County, and three nests with eggs were taken. Anderson listed these additional records: a specimen was taken by Paul Bartsch at Burlington, Des Moines County, during the spring of 1889; one was secured by B. H. Wilson in the same locality April 20, 1899; an immature male was taken by W. G. Savage in Van Buren County, during 1895; it was recorded as a summer resident in Lee County (Praeger, Currier, and Berry); it was seen a few times in Marshall County (A. P. Godley).

DuMont (1931) recorded that Lester P. Fagen found a pair nesting in Polk County during two or three summers between 1903 and '06. There is a mounted pair of these birds in the Coe College Museum, taken by E. H. King at West Liberty, Muscatine County. The female was secured May 14, 1880 and the male was taken during 1885. A male and a female in the Dwight collection, American Museum of Natural History, were secured by Walter G. Savage at Hillsboro, Henry County, during 1895. The male was obtained June 10 and the female May 3.

There are no recent records. Rudolf Bennitt wrote that he had no recent reports from northern Missouri.

Family *Fringillidae*

Richmondia cardinalis cardinalis (Linnaeus). Eastern Cardinal

A permanent resident, breeding in all parts of the state. It is a common bird in the southern two-thirds and along the Mississippi and Missouri River valleys, somewhat rare in the extreme north-central part of Iowa.

The extension of the range of this Carolinian species into all parts of Iowa has attracted unusual interest among local bird students. The first appearance of this bird was noted in the following localities: one was caught in a box trap at Iowa City, Johnson County, during February, 1882; one was reported at Des Moines, Polk County, in 1885; Charles Ruben Keyes reported many observations of it in Linn County after 1901; it was noted in the vicinity of Sioux City, Woodbury County, in 1902 by D. H. Talbot; it was reported in Jasper County during the same year; in 1907 Anderson included records from Webster County (Somes), Jackson County (Giddings), and Blackhawk County (Peck); Peck stated that twenty years before it had been considered accidental in Blackhawk County, but in 1906 it was frequently seen; it was first reported in Sac County during the winter of 1913-14; it appeared in Floyd County during 1916, and in Mitchell County the next year; Hendrickson noted this bird in the extreme northwest corner of Lyon County during the summer of 1928; O. S. Thomas saw it eight miles south of Rock Rapids, Lyon County, during February, 1929, and observed that in the next two years it moved twenty miles northward; Wolden reported that the first record in Emmet County was in 1933. In the Mississippi River Valley the advance was more rapid. After 1914 it became a regularly established bird in southeastern Minnesota.

DuMont (1931) has summarized the numbers of these birds at Des Moines, Polk County, as recorded on the Bird-Lore Christmas Census. In 1923 eight observers found thirty-six cardinals, and in 1929 seventeen observers reported one hundred and forty-nine. Spiker (1926) recorded that he saw thirty-seven during a half mile walk at Sioux City, Woodbury County, February 18, 1924.

Hedymeles ludovicianus (Linnaeus). Rose-breasted Grosbeak

A common summer resident, breeding throughout the state.

Guiraca caerulea interfusa Dwight and Griscom.

Western Blue Grosbeak

A rare straggler into the western part of the state. Bennett (1931) stated that it was uncommon in Nebraska near Sioux City. Youngworth observed a bird of this species in Woodbury County upon three different occasions during 1932, but in each instance was unable to collect it. On June 25, he noticed a male about a mile east of Sioux City. On June 28, another was seen five miles northwest of

the city. Another was noted September 19. Roberts had one of these birds under observation for fifteen minutes at Spirit Lake, Dickinson County, May 18, 1924. Hendrickson observed a male at Cedar Falls, Blackhawk County, during June, 1923. He stated that the large bill was seen distinctly. One of these birds was noted at Omaha, May 15, 1926 (Letter of Information of the Nebr. Orni. Union). Swenk considers this a fairly common species in all parts of Nebraska. A series of Nebraska skins recently examined by H. C. Oberholser were determined as *interfusa*. The birds occurring in northwestern Iowa probably are of this race, but the Blackhawk County bird may have straggled north through the Mississippi River Valley, and may have been *caerulea*. Rudolf Bennitt wrote that the latter form was the common one in eastern Missouri. Iowa specimens are greatly needed.

Passerina cyanea (Linnaeus). Indigo Bunting

A common summer resident, breeding in all parts of the state. It was reported as fairly common in Emmet County (Wolden), and in Dickinson County (Roberts).

Passerina amoena (Say). Lazuli Bunting

Accidental. William Youngworth recorded (Wilson Bull., XLI, p. 190) the only Iowa observation, a male in full breeding plumage seen within the limits of Sioux City, Woodbury County, May 20, 1929. This bunting was studied with 10-power glasses and its characteristic markings were noted. Youngworth was previously acquainted with this species in North Dakota, and consequently feels sure of his identification.

Spiza americana (Gmelin). Dickcissel

A common summer resident, breeding in all parts of the state. There has been but little variation in numbers during the past sixty years. Allen (1868) recorded it as one of the most abundant birds in western Iowa.

Hesperiphona vespertina vespertina (Cooper).

Eastern Evening Grosbeak

An irregular and rare winter visitor, most frequently reported from the northern part of the state. Spiker (1924) recorded a flock of five at Ottumwa, Wapello County, April 24, 1911. Nauman reported

that he had seen three in Keokuk County. Allert reported it as an uncommon winter visitor in Clayton County.

On the basis of records included by Anderson (1907) and the numerous specimens, this bird must have occurred in southern Iowa in much greater numbers before 1900 than it does at the present. A series of thirteen specimens was examined by J. Van Tyne, who determined them all as *vespertina*. One of them, a male, No. 12595, in the Dwight collection, American Museum of Natural History, was taken by Walter G. Savage at Hillsboro, Henry County, December 2, 1898. J. T. Zimmer wrote that it was close to *brooksi*, but not quite typical of it. A male taken in Linn County during February, 1904, has a yellow frontal stripe measuring 6.5 mm. A male taken in Johnson County during March, 1887, has a frontal stripe of 6.9 mm. In this respect both specimens approach *brooksi*.

Carpodacus purpureus purpureus (Gmelin). Eastern Purple Finch

A fairly common migrant in the eastern part of the state and an uncommon migrant in the western part. It is an uncommon winter resident in the southern portion of Iowa and irregular or rare in the north. Anderson (1907) recorded that a nest was found by David L. Savage near Salem, Henry County, June 2, 1892. This is the only breeding record.

Pinicola enucleator leucura (Müller). Canadian Pine Grosbeak

A very rare winter visitor. Anderson (1907) stated that it occasionally appeared as a straggler in winter. A summary of the county records that he listed is as follows: during the winter of 1878-79 a few small flocks were seen at Charles City, Floyd County (Keyes and Williams, 1889); three were seen by J. W. Lindley during the winter of 1883-84 in Mitchell County; Somes reported a few in winter in Webster County; Peck reported it as a rare autumn and spring visitor in Hardin County; Herbert Osborn recorded that one specimen was taken at Ames, Story County, December 23, 1889; Giddings stated that on December 1, 1903 two males were shot at the mouth of the Maquoketa River, Jackson County, and that one of them was sent to him.

DuMont (1931) recorded that Lester P. Fagen saw four or five of these birds in Polk County during the winter of 1904. Fenton (1923-24) stated that he observed a flock of eight at Charles City, Floyd County, January 5, 1918. Spiker (1926) recorded observa-

tions of single birds at Sioux City, Woodbury County, October 24 and 31, and November 25, 1922. On November 2, 1924 a group of people from the Sioux City Bird Club observed a male north of Stone Park in Plymouth County (Wilson Bull., XXXVII, p. 41). Wolden reported it as a very rare winter visitor in Emmet County. Spiker listed it as rare in Chickasaw County.

The only specimen is one in the Philadelphia Academy of Natural Sciences collected during the winter in Mitchell County. There is no further data.

Leucosticte tephrocotis tephrocotis (Swainson).

Gray-crowned Rosy Finch

Accidental in Iowa. Anderson (1907) stated that the only definite record he had found was that of D. H. Talbot, at Sioux City, who stated that in February, 1883 (an extremely cold month) several specimens were captured by boys in the western part of the city. Talbot described (Bull. Nuttall Orni. Club, VIII, pp. 240-242) in detail the breeding plumage of one of these birds which he kept in captivity. There are no specimens.

Acanthis linaria linaria (Linnaeus). Common Redpoll

An irregular winter visitor, occasionally appearing in considerable numbers. All observers in the southern part of the state have reported it as rare. Wolden listed it as a common winter resident in Emmet County.

Acanthis linaria rostrata (Coues). Greater Redpoll

A very rare winter straggler. J. H. Brown recorded (Iowa Orni., II, p. 50) that he shot three Greater Redpolls at Iowa City, Johnson County, on January 11, 1896 and one on January 13. He believed them to be undoubtedly of this variety. There is a record in the files of the U. S. Biological Survey of nine specimens taken January 18 and 25, 1896 in Johnson County. They were determined as *rostrata* by A. K. Fisher. The present location of these specimens is not known.

Spinus pinus pinus (Wilson). Northern Pine Siskin

An uncommon and erratic migrant, and an irregular winter visitor, occasionally appearing in considerable numbers. There are several sporadic nesting records in Woodbury County. It was recorded by

Roberts as a migrant only in Dickinson County. Spiker (1924) furnished the most southerly record, April 18, 1913 and March 24, 1914 in Wapello County. Gabrielson (1919) recorded that from May 13 to 18, 1914 they were present by the thousands in Marshall County.

The first Iowa breeding record was secured by W. J. Hayward at Sioux City, Woodbury County, April 13, 1914 (Wilson Bull., XXVI, p. 140). Mrs. Marie Dales found a nest in the same locality April 3, 1926. A heavy storm blew it down before the eggs were laid. May 20, 1928, another nest was seen by Mrs. Dales at Sioux City. One young was successfully reared. Youngworth (1931) recorded that there had been several nesting records of the Siskin in Sioux City since 1926.

Spinus tristis tristis (Linnaeus). Eastern Goldfinch

A fairly common permanent resident in the southern part of the state, less numerous in the north. During the summer it is a very common breeding bird throughout the state.

A small series of specimens from Woodbury County was examined by J. Van Tyne, who determined them all as *tristis*. With sufficient collecting, *pallidus* should be found as a migrant in the western part of the state.

Loxia curvirostra pusilla Gloger. Red Crossbill

An irregular winter and spring visitor occasionally appearing in small flocks in the northern part of the state, rare in the southern half. Spiker (1926) recorded that it was unusually common in Woodbury County during the winter of 1923-24. Widmann (1907) recorded that five specimens had been collected at Keokuk, Lee County. Spiker (1924) listed it in Wapello County. Youngworth recorded (Iowa Bird Life, I, p. 47) two seen September 29, 1931, in Woodbury County.

On the basis of specimens examined, this race appears to visit Iowa less frequently than Bendire's Crossbill, a Rocky Mountain subspecies. Measurements of six specimens of *pusilla* are as follows:

County	Date	Sex	Wing	Tail Exposed		Height at
				culmen	base	
Johnson	Nov. 26, 1887	male	86.4	49.5	15.0	8.4
Woodbury	Oct. 4, 1900	male	72.9	45.0	17.3	8.6
Dallas	Mar. 23, 1895	female	88.9	----	17.1	8.4
Dallas	Mar. 23, 1895	female	85.6	----	15.2	8.9
Dallas	Mar. 23, 1895	female	83.3	----	16.3	8.9
Johnson	Nov. 26, 1887	female	84.1	47.5	13.5	7.9

Loxia curvirostra bendirci Ridgway. Bendire's Crossbill

Twelve specimens of this Rocky Mountain form have been examined. Five were collected in Woodbury County, three in Webster County, one in Poweshiek County, two in Johnson County, and one in Jackson County. The latter was taken at Sabula, the most easterly town in Iowa. This would indicate a statewide distribution.

Measurements of the twelve specimens of *bendirci* are as follows:

County	Date		Sex	Wing	Tail	Exposed culmen	Height at base
Woodbury	Feb	17, 1886	male	90 7	51 6	18 5	9 4
Woodbury	Feb	17, 1886	male	88 9	52 6	17 0	8 6
Webster	Nov	7, 1891	male	91 7	54 4	17 3	9 9
Webster	Nov	7, 1891	male	88 9	50 8	17 3	9 4
Poweshiek	----	---, ----	male	91 4	53 3	17 3	9 1
Woodbury	Feb	17, 1886	female	87 9	50 0	19 8	8 9
Woodbury	Feb	17, 1886	female	83 8	46 2	17 3	--
Woodbury	Feb	17, 1886	--	86 4	47 2	18 5	8 9
Webster	Nov	7, 1891	female	88 9	50 8	16 8	9 1
Johnson	Jan	----, 1889	female	92 2	54 9	17 5	9 4
Johnson	Nov	26, 1886	female	84 8	50 8	17 0	8 6
Jackson	---	---, ----	female	83 8	---	16 0	--

Loxia leucoptera Gmelin. White-winged Crossbill

A rare winter visitor. A summary of the records listed by Anderson (1907) is as follows: Guy C. Rich reported it as an uncommon winter resident in Woodbury County; M. E. Halversen observed it during the fall of 1900 at Iowa Falls, Hardin County; one collected by C. K. Salisbury in Blackhawk County about 1902; George H. Berry secured one in Linn County during the winter of 1893; J. T. Paintin noted a flock that summered at Iowa City, Johnson County, in 1885; Walter G. Savage identified one that was shot in Van Buren County, about 1896; William Savage saw one in the same county in 1881; Lynds Jones reported it as a rare winter visitor in Poweshiek County; Herbert Osborn considered it rare at Ames, Story County; I. S. Tostler reported it as an irregular winter visitor in Pottawattamie and Mills counties.

Stephens (1920) recorded that small flocks of eight or ten were seen each day by Miss Ada B. Wendell at Smithland, Woodbury County, from December 10, 1919 throughout the winter. DuMont (1931) stated that Lester P. Fagen had two records for Polk County. Notes from the files of the U. S. Biological Survey are as follows: one was noted by C. K. Salisbury at Reinbeck, Grundy County, July

27, 1896; one was found dead by Leroy Titus Weeks at Emmetsburg, Palo Alto County, November 27, 1920. Allert has a male in his collection taken at Giard, Clayton County, November 22, 1926.

Pipilo erythrophthalmus erythrophthalmus (Linnaeus). Red-eyed Towhee

A common migrant and a common summer resident throughout the state, somewhat less numerous as a breeder in north-central Iowa. Anderson (1907) listed several wintering records. It has recently been noted during the winter in Woodbury and Polk counties.

Pipilo maculatus arcticus (Swainson). Arctic Towhee

An uncommon migrant in the Missouri River Valley region. The only Iowa records are from the northwestern corner of the state. Youngworth recorded (Wilson Bull., XLIII, p. 223) a specimen collected in either Woodbury County, Iowa, or Union County, South Dakota, during the spring of 1931. He also recorded (Iowa Bird Life, II, p. 52) that October 18, 1928 was the latest date that he had observed this species at Sioux City. A male and a female in Youngworth's collection were taken at Hinton, Plymouth County, October 9, 1931. A male in the T. C. Stephens collection was secured by Youngworth in Plymouth County. It was noted at Omaha, Nebraska, May 4, 1929 (Letter of Information of the Nebr. Orni. Union).

Calamospiza melanocorys Stejneger. Lark Bunting

A rare and irregular migrant in the northwestern part of the state (Bennett). A summary of the records given by Anderson (1907) is as follows: Audubon recorded that Bell killed two of these birds on "Blackbird's Hill," Harrison County, May 13, 1843; John Krider collected two in Winnebago County during the spring of 1875; I. S. Trostler reported it as a scarce summer resident in Pottawattamie County; George H. Berry shot two males in Sioux County during 1890; Guy C. Rich collected a male near Sioux City, Woodbury County, June 6, 1897, and noted another May 21, 1901.

Concerning the recent history of this bird, Walter W. Bennett wrote as follows: "From 1908 to 1925 there seemed to be none of them near Sioux City, Iowa, and I am told that their absence dated from about the nineties. Dr. Thomas S. Roberts thinks it reappeared in 1927, at least in Pipestone County, Minnesota, but my records indicate it began to be seen in the Sioux City area after May 17, 1925 when T. M. Murdoch and I saw one near Brown's

Lake. It was found soon afterwards by E. A. Fields at Marcus, Cherokee County, and by other observers, although never more than two or three were seen at a time, none nesting."

Spurrell recorded (Wilson Bull., XXXIII, p. 126) observations in Sac County, May 19, 1908 and May 9 and 22, 1914. A. B. Darling recorded (*ibid*, XXXIX, p. 170) one seen at Anthon, Woodbury County, June 5, 1927. Roberts stated (*ibid*, XL, p. 50) that large numbers were seen during the breeding season of 1927 at Gitchie Manito State Park, extreme northwestern Lyon County. Hendrickson reported that a few were observed in the same locality during the summer of 1928. The writer has seen no Iowa specimens.

Passerculus sandwichensis savanna (Wilson).

Eastern Savannah Sparrow

A fairly common migrant in all parts of the state, reported by a few observers as a common migrant. Anderson (1907) listed reports of it as a summer resident in Woodbury, Polk, Poweshiek, Mahaska, Decatur, Van Buren, and Jackson counties. It has recently been recorded as a breeder in the following localities: Chickasaw County (Spiker); Hamilton County (DuMont); Dickinson County (Roberts).

A small series of specimens from central Iowa was identified by H. C. Oberholser as typical *savanna*.

Passerculus sandwichensis nevadensis Grinnell.

Nevada Savannah Sparrow

A rare migrant in Iowa. A single specimen, No. 22800 in the University of Iowa Museum, was secured by R. M. Anderson at Iowa City, Johnson County, May 13, 1901. This specimen was identified by H. C. Oberholser as *alaudinus*. He stated that it should be so-named because *nevadensis* is properly a synonym of *alaudinus*. Therefore *nevadensis* should disappear from the literature. However, the rearrangement of these names has not been approved by the A. O. U. Committee on Nomenclature, and until such a time as they are it seems advisable to follow the last Check-List.

This subspecies has not heretofore been recorded from Iowa.

Ammodramus savannarum australis Maynard.

Eastern Grasshopper Sparrow

Some form of Grasshopper Sparrow is a common summer resident, breeding throughout the state. Anderson (1907) listed two specimens

as *bimaculatus* that were determined as *perpallidus* = *bimaculatus* by Robert Ridgway. One of these specimens, a male, No. 22961 in the University of Iowa Museum, was collected by Anderson at Forest City, Winnebago County, June 3, 1893. It was recently examined by J. Van Tyne who stated that while it was rather larger, in color it belonged definitely in their series of *australis*. The second specimen, No. 22962 in the same collection, was taken by Anderson at Forest City, October 5, 1894. Being in fall plumage and incomparable with breeding specimens it was not identified by Van Tyne. A series of five adult males, one adult female, and two immature contained in the Museum of Zoology, Ann Arbor, Michigan, was secured by Ruthven and Peet during the summer of 1907 in Clay and Palo Alto counties. Van Tyne wrote that these seemed to be *australis*, and that two were so identified by H. C. Oberholser. A spring adult, No. 1580 in the Coe College Museum, probably taken in Linn County, and a breeding male, No. 101 in the writer's collection, which was secured in Polk County, June 6, 1932 were both identified by Van Tyne as *australis*. Both of these are identical in coloration with breeding males from Connecticut.

There is a series of four specimens from Mitchell County, collected during July 29 and 30, and August 2, 1879, and three specimens from Dickinson County secured during July, 1881 now in the Philadelphia Academy of Natural Sciences. All were collected by W. L. Abbott. Witmer Stone identified them all as *perpallidus*=*bimaculatus*. A male in the Dwight collection, American Museum of Natural History, was taken by Walter G. Savage at Hillsboro, Henry County, April 26, 1895. It was identified by the writer as *bimaculatus*. Four specimens in the collection at Iowa State College, were taken by Charles Rollin Keyes at Des Moines, Polk County, during April, 1884, '85, and '86. These were determined as *bimaculatus* by the writer. A male, No. 25184 in the University of Iowa Museum, was secured by L. L. Snyder at Iowa City, Johnson County, April 19, 1917. It is definitely *bimaculatus*.

Ammodramus savannarum bimaculatus Swainson.

Western Grasshopper Sparrow

Apparently a common summer resident in various parts of Iowa. For a discussion of its distribution and abundance see "Eastern Grasshopper Sparrow."

Passerherbulus caudacutus (Latham). Leconte's Sparrow

An uncommon migrant in all parts of the state. There are numerous specimens. There is no satisfactory evidence that it has ever bred in the state. This bird normally arrives during the last of March or early in April, or at least a month before the Nelson's Sparrow, a species with which it may be confused

Passerherbulus henslowi henslowi (Audubon).

Western Henslow's Sparrow

A fairly rare migrant. The only recent report of this bird during the summer was furnished by Spiker who reported it as rare in Chickasaw County. The report by Fenton (1923-24) that it is a tolerably common summer resident throughout Floyd County must be considered as an exaggeration. There are no recent breeding records.

Either this bird has been overlooked by present observers or it has decreased considerably in numbers during recent years. Anderson (1907) recorded it as a tolerably common summer resident and listed it from the following localities: western Iowa, less common than Grasshopper Sparrow (Allen, 1868); Decatur and Mahaska counties, common and breeding (Trippe, 1872); Grundy County, one nest, female shot in 1899 (Bingaman); Lee County, summer resident (Praeger and Currier); Linn County, tolerably common summer resident, ten pairs breeding in 1900 (Berry); Poweshiek County, summer resident (Kelsey and Lynds Jones).

There is a mounted specimen in the University of Iowa Museum, taken by Frank Bond at Tiffin, Johnson County. A juvenile collected by Ruthven in Clay County, August 29, 1907 is in the Museum of Zoology, Ann Arbor, Michigan.

Ammospiza caudacuta nelsoni (Allen). Nelson's Sparrow

Reported as a migrant only in Iowa. Anderson (1907) stated that Paul Bartsch took an adult male at Iowa City, Johnson County, October 12, 1894. A male and a female in the University of Iowa Museum, were collected by R. M. Anderson near Iowa City, May 27, 1904.

Bennett (1931) recorded it as a rare migrant in the Sioux City region, and mentioned that a specimen had been taken by Guy C. Rich. DuMont (1931) listed it as an uncommon migrant in Polk County. It was noted there once in the spring, May 27, 1929, and eight fall records ranged from August 30 to October 18. The writer

observed one in Dallas County, June 12, 1928. The lateness of the date suggested breeding, but no nest was found. Rosene found this bird in Boone County, May 15, 1933. A specimen in the museum of Iowa State Teachers College, was collected by C. W. Walters at Cedar Falls, Blackhawk County, May 21, 1900.

It is the opinion of the writer that Nelson's Sparrow is a regular and moderately common migrant through Iowa, and may be found breeding. It is probably overlooked by most bird students because of its late date of arrival (usually after May 20), and because of its habit of remaining along the water's edge in marshes and sloughs.

Pooecetes gramineus gramineus (Gmelin). Eastern Vesper Sparrow

A common migrant, a common summer resident in the northern half of the state, less numerous in the southern part. One bird was noted in Polk County during December, 1928. A small series of skins was examined by H. C. Oberholser who determined them as *gramineus*.

Chondestes grammacus grammacus (Say). Eastern Lark Sparrow

A common summer resident in the western two-thirds of the state, uncommon in the eastern portion. It was unreported from a few of the heavily wooded localities in eastern and southeastern Iowa. All specimens examined were referable to this race, although *strigatus* is a migrant through the Missouri River Valley.

Junco hyemalis hyemalis (Linnaeus). Slate-colored Junco

An abundant migrant and a common winter resident in all parts of the state. A large proportion of the migrant Juncos pass south of Iowa to winter, but flocks of considerable size remain, especially in the southern part.

The writer has seen no Iowa specimen of Junco which was not clearly *hyemalis*. There are numerous sight records reported as "Montana Junco" which probably are based on pink-sided female *hyemalis*, and not the black-headed, brownish-backed *Junco oregonus*. A race of the latter species, Shufeldt's Junco, *J. o. shufeldti* Coale, has been recorded as a regular migrant in eastern Nebraska, with several records at Omaha. W. E. Praeger collected one on the Illinois side of the Mississippi River, across from Keokuk, December 16, 1892. It was identified at the American Museum of Natural History as *shufeldti*.

Spizella arborea arborea (Wilson). Eastern Tree Sparrow

A common winter resident throughout the state. Twenty-three specimens, including eight from Sioux City, were identified by H. C. Oberholser as this subspecies.

Spizella arborea ochracea Brewster. Western Tree Sparrow

A fairly common migrant in all parts of Iowa. Twelve specimens examined by H. C. Oberholser and determined as *ochracea*, were secured in the following localities: Sioux City, Woodbury County, three males; Blue Lake, Monona County, one, sex not recorded; Jasper County, a female; Poweshiek County, two, sex not recorded; Iowa City, Johnson County, two males; Cedar Rapids, Linn County, two females; Giard, Clayton County, one male. This subspecies has not been recorded before from Iowa.

Spizella passerina passerina (Bechstein). Eastern Chipping Sparrow

A common summer resident, breeding throughout the state. It was reported by a few observers as abundant,

Spizella pallida (Swainson). Clay-colored Sparrow

A fairly common migrant. Anderson (1907) listed it as a rare migrant in most localities in eastern Iowa, and tolerably common in the central and western part. He recorded breeding records for Winnebago, Kossuth, and Jackson counties.

Allert reported it as a common migrant in Clayton County. Bennett and Youngworth noted it as a common migrant in the Sioux City region. A few observers reported it as rare. The only recent breeding record was furnished by F. L. R. Roberts who reported it as nesting at Estherville, Emmet County. Roberts (1932) recorded it as an abundant summer resident in Minnesota, breeding throughout that state.

Spizella pusilla pusilla (Wilson). Eastern Field Sparrow

A common summer resident, breeding in all parts of the state. There is one winter record reported from Polk County (DuMont, 1931).

Spizella pusilla arenacea Chadbourne. Western Field Sparrow

A migrant in Iowa. Three specimens were identified by J. Van Tyne. These are: a male in Youngworth's collection, secured by him in Woodbury County, April 17, 1931; a female, No. 1494 in

the Coe College Museum, taken by Kubichek at Amana, Iowa County, October 20, 1928; a female, No. 568 in Allert's collection, secured by him at Giard, Clayton County, October 15, 1931. This is the first record of this subspecies in Iowa.

Zonotrichia querula (Nuttall). Harris's Sparrow

A common migrant in all parts of the state. Apparently this bird has become more numerous as a migrant in eastern Iowa since 1907. Anderson recorded it rare or irregular in the eastern third of the state. It was recently reported as a common migrant in Clayton County (Allert), Chickasaw County (Spiker), and Floyd County (Fenton). Pierce (1930) noted it as a fairly regular migrant in Buchanan County. Nauman reported it as a fairly common migrant in Keokuk County. All observers in the western two-thirds of the state report it as a common migrant. DuMont (1931) listed five winter dates for Polk County. Weir R. Mills noted one at Pierson, Woodbury County, December 27, 1927. Stephens (1918) listed several wintering records from Woodbury County. Youngworth (1931) noted one in the same locality, December 5, 1926.

Zonotrichia leucophrys leucophrys (Forster). White-crowned Sparrow

A fairly common migrant in all parts of the state. It appears in numbers about equal with *Z. l. gambeli*, although the latter is somewhat more numerous in western Iowa. There are numerous specimens.

Zonotrichia leucophrys gambeli (Nuttall). Gambel's Sparrow

A fairly common migrant, most numerous in the western part of the state. Anderson (1907) listed several specimens. I. S. Trostler considered it a common migrant in Pottawattamie and Mills counties. Roberts reported that at a banding station at Spirit Lake, Dickinson County, more Gambel's Sparrows than White-crowned Sparrows were taken.

Zonotrichia albicollis (Gmelin). White-throated Sparrow

An abundant migrant throughout the state. A single winter record is from Polk County.

Passerella iliaca iliaca (Merrem). Eastern Fox Sparrow

A common migrant in all parts of the state. One wintering record is from Polk County.

Melospiza lincolni lincolni (Audubon). Lincoln's Sparrow

A common migrant in all portions of Iowa. A casual occurrence of this bird was reported from Polk County December 26, 1926.

Melospiza georgiana (Latham). Swamp Sparrow

A common migrant throughout the state. Anderson (1907) recorded it as a rare summer resident in Dickinson, Kossuth, Winnebago, Winneshiek, Boone, Jackson, Linn, and Lee counties. There are no recent reports of breeding. Spurrell (1921) stated that it was a common migrant and breeder in Sac County, and that during the nesting season its clear song was a very pleasing feature of the marshes that it frequented. However, he did not mention the finding of any nests. Roberts (1932) recorded it as a common summer resident in all parts of Minnesota, therefore it might be found in northern Iowa.

Melospiza melodia beata Bangs. Mississippi Song Sparrow

A very common migrant, a summer resident, breeding throughout the state, except perhaps in the northwestern part. It is an uncommon permanent resident in the southern half of Iowa and it has been noted infrequently during the winter in the northern portion. It has not been determined whether the breeding bird in southern Iowa is actually a permanent resident or whether, during the winter, it is replaced by the migrant, *juddi*. There is no evidence that the Eastern Song Sparrow, *Melospiza m. melodia* (Wilson), occurs in the state.

As the result of a study of fifty-eight specimens by H. C. Oberholser, Roberts (1932) listed the breeding song sparrow in Minnesota as *juddi*. There appears to be no consideration given to *beata*, which, according to the A. O. U. Check-List, 4th Edition, occupies the entire Mississippi Valley region.

A series of skins was examined by J. Van Tyne who determined the six Iowa breeding birds as *beata*. These were taken in Allamakee, Linn, Johnson, Iowa, and Marshall counties. Three others, not examined by Van Tyne, were identified by the writer as *beata*. They were from Johnson and Poweshiek counties. No breeding specimens were available from northern or western Iowa. When sufficient material is examined, *juddi* will probably be found as a breeder in these areas, at least in the northwestern part. Fall specimens were not determined by Van Tyne as the plumage at that time of year is considerably different from that of the breeding season.

Melospiza melodia juddi Bishop. Dakota Song Sparrow

A common migrant in all parts of Iowa, and probably a summer resident in the northwestern part. J. Van Tyne identified the following specimens of *juddi* from Iowa: a male, March 27, 1932, Clayton County; a male, April 17, 1925, Linn County; a male, March 27, 1902 Johnson County. A male taken at McCook Lake, Union County, South Dakota, April 16, 1931, was determined as *juddi*. Two specimens identified by the writer were collected by W. A. Willard in Jasper County, April 6, 1896. A specimen in the Stephens collection was secured by Arthur R. Abel at Sioux City, Woodbury County, May 4, 1918. It was identified by H. C. Oberholser as *juddi*, which might be considered the breeding form in that area.

Rhynchophanes mccowni (Lawrence). McCown's Longspur

Formerly a migrant. Anderson (1907) stated that I. S. Trostler reported is as a common migrant in Pottawattamie County. Trostler said that he had identified specimens, which he had collected, to be McCown's Longspur. Lynds Jones recorded (Wilson Bull., IV, p. 27) that a flock of twenty was seen at Grinnell, Poweshiek County, March 3, 1887. Roberts (1932) recorded that it was once a common summer resident along the southwestern border of Minnesota. It disappeared from there entirely about 1900. There are no Iowa specimens.

Calcarius lapponicus lapponicus (Linnaeus). Lapland Longspur

A common winter resident throughout the prairie regions of the state. Frequently it has been noted in flocks containing several thousand birds. It has been reported as somewhat less numerous in northern Iowa during midwinter, and appearing in numbers during the migratory periods, November and March. No specimen of the Alaska Longspur, *C. l. alascensis* Ridgway, has been found among the Iowa material.

Calcarius pictus (Swainson). Smith's Longspur

A somewhat rare and irregular late fall or early spring migrant, occasionally appearing in numbers. It has been noted during the winter in southern Iowa. There are a number of recent observations. DuMont (1931) recorded that there was a male and a female in the Keyes collection, Iowa State College, taken in Polk County, April 18, 1885. A male in the University of Iowa Museum was taken at the same time. One in the museum at Iowa State Teachers College

was taken by Harry Fields at Cedar Falls, Blackhawk County, April 22, 1899. Five specimens in the Coe College Museum were collected by Kubichek at Amana, Iowa County, during April, 1928 and 1929.

Calcarius ornatus (Townsend). Chestnut-collared Longspur

A fairly rare migrant in the western part of the state. Anderson (1907) listed it from Howard, Linn, Van Buren, Poweshiek, Jefferson, Pottawattamie, and Winnebago counties. He stated that M. Earle Halverson shot one at Forest City, Winnebago County, in 1903.

Lynds Jones recorded (Wilson Bull., IV, p. 27) that during 1887 several hundred remained for several weeks at Grinnell, Poweshiek County. Spurrell (1919) recorded two seen at Wall Lake, Sac County, during the fall of 1912. Fenton (1923-24) recorded that a specimen taken at Charles City, Floyd County, and contained in the Miles collection, was identified as this species by B. H. Bailey. Wolden reported that he observed a large flock of these birds in Emmet County late in the winter of 1932-33. He wrote that he was able to make out the whitish throats and the dark breasts, although the birds were not in full breeding plumage. The writer has examined no Iowa specimens.

Plectrophenax nivalis nivalis (Linnaeus). Eastern Snow Bunting

An uncommon and irregular winter visitor in the northern part of the state, rarely noted in the southern part. There are several specimens.

HYPOTHETICAL LIST

The eighteen species contained in this list have been placed here because of insufficient evidence for inclusion in the body of the paper. A few of these have been reported from adjoining states, and might be expected in Iowa.

Family Anatidae

Dendrocygna bicolor helva Wetmore and Peters. Fulvous Tree Duck

F. L. R. Roberts recorded (Wilson Bull., XLIV, p. 180) that in the fall of 1931 a duck was shot by a Mr. Wendell of Estherville, which was probably this species. It was taken to F. P. Hopkins of Spirit Lake, who stated that it was shot from a tree; its legs were about twice as long as those of a teal, and blue-black in color; its bill was short, dark, and somewhat broad. The rest of the description fitted this species. Unfortunately it was not preserved.

Paul L. Errington reported that Frank Marnette had told him of watching a Fulvous Tree Duck on Spirit Lake, from a distance of only a few feet. Presumably this was about the same time as the occurrence mentioned above, although no date was noted.

Roberts (1932) recorded a field identification of two seen in Lincoln County, Minnesota, by W. J. Breckenridge on May 24, 1929.

Anas rubripes tristis Brewster. Common Black Duck

All of the Black Duck records for Iowa were recorded by Anderson (1907) as *Anas obscura*=*A. r. tristis*. However, subsequent examination of several of the specimens listed by Anderson prove, in each case, that the bird is referable to *A. r. rubripes*.

J. A. Allen (1868) recorded that the Black Duck was not uncommon in summer in western Iowa, along the rivers and in the grassy ponds. It is possible that in earlier days the Black Duck occasionally bred, or at least was a summer resident, in the state. If that were true, certainly those birds would have been the Common Black Duck.

Mareca penelope (Linnaeus). European Widgeon

This bird has been recorded from Minnesota (1929 and 1931), Nebraska, Missouri, Illinois, and Wisconsin. It might be expected to occur here.

Glaucionetta islandica (Gmelin). Barrow's Golden-eye

There is no satisfactory evidence for including this species. Anderson (1907) recorded a specimen in the University of Iowa Museum, taken by Robert E. Leach at Independence, October 11, 1892 and identified by C. C. Nutting. A recent examination has shown this to be a female *G. clangula americana*. Anderson listed several field observations none of which were sufficiently satisfactory to establish a record.

Roberts (1932) recorded that the specimen from Fillmore County, Minnesota, listed by Hatch (Birds of Minn., 1892) proved to be *G. c. americana*.

Family Rallidae

Ionornis martinica (Linnaeus). Purple Gallinule

Anderson (1907) stated that it was listed by J. A. Allen, and that John Krider found it breeding in Iowa. A specimen taken by Morton E. Peck in Blackhawk County was listed. Peck recently

wrote that this bird was observed, not collected. He stated that he did not doubt the correctness of the identification.

Family Scolopacidae

Numenius americanus occidentalis Woodhouse. Northern Curlew

H. C. Oberholser recorded (Auk, XXXV, p. 194) two Iowa specimens as referable to this poorly defined subspecies. One specimen had no more definite locality than "Iowa," the other was from Chariton, Lucas County, March 21, —. Oberholser wrote that he had been unable to trace the location of these two specimens.

Calidris canutus rufus (Wilson). American Knot

Anderson (1907) placed this bird in his hypothetical list. It was listed by J. A. Allen, and John Krider stated that he had found it during May in northern Iowa. It has occurred in all the states surrounding Iowa and might be collected here.

Family Phalaropodidae

Phalaropus fulicarius (Linnaeus). Red Phalarope

This species was listed by J. A. Allen (White's Geol. of Iowa, 1870). Anderson (1907) listed a report by George H. Berry from Sioux County. There are no Iowa specimens. T. C. Stephens recorded (Wilson Bull., XXVIII, p. 92) a specimen taken in Union County, South Dakota, November 28, 1912. It was secured but a few miles west of Sioux City, Iowa.

Family Strigidae

Surnia ulula caparoch (Müller). American Hawk Owl

Anderson (1907) listed it on the basis of a statement by George H. Berry that he had taken one specimen in Iowa, and had observed one in December, 1903, near Cedar Rapids, Linn County. The latter was not secured. The writer has been unable to find a specimen.

Cryptoglaux junerea richardsoni (Bonaparte). Richardson's Owl

This species was placed in the hypothetical list by Anderson (1907). He stated that it had been reported from Linn and Webster counties, but that no specimens had been taken.

Family Turdidae

Hylocichla fuscescens fuscescens (Stephens). Veery

All records of *Hylocichla fuscescens* in Iowa were referred to this

race by Anderson (1907), and *salicicola* was placed in his hypothetical list. A recent study of specimens shows that the opposite is true. Certain specimens appear to be more or less intermediate. A typical example of *fuscescens* might be taken.

Myadestes townsendi (Audubon). Townsend's Solitaire

Anderson (1907) placed this bird in his hypothetical list. He noted occurrences in Illinois and Nebraska, but none in Iowa. Roberts (1932) recorded three occurrences in Minnesota, one of them being of a male taken by G. H. Leudtke eight miles southeast of Fairmont, Martin County, November 30, 1916. This locality is but a few miles from the Iowa line. One was seen at Omaha, Nebraska, March 4, 1926 (Letter of Information of the Nebr. Orni. Union).

Family Laniidae

Lanius ludovicianus excubitorides Swainson. White-rumped Shrike

The records of *Lanius ludovicianus* as recorded by Anderson (1907) were somewhat confused. *Migrans* had been described but a few years before. It is doubtful now how many of those records referred to *excubitorides*. Specimens recently examined all proved to be *migrans*. No specimens of *excubitorides* have been found.

Family Fringillidae

Hedymeles melanocephalus papago Oberholser.

Rocky Mountain Grosbeak

Anderson (1907) included this bird in his hypothetical list and stated that it had been reported in Nebraska during migration east rarely to Omaha. One was reported from there May 17, 1930 (Letter of Information of the Nebr. Orni. Union). It appears to be extending its range eastward in South Dakota, Youngworth having found it breeding in Yankton County, in that state, July 6, 1931.

Acanthis linaria holboelli (Brehm). Holboell's Redpoll

H. C. Oberholser wrote that five specimens were taken in Johnson County, January 18 and 25, 1896. They were identified by A. K. Fisher. These specimens cannot now be found.

Ammodramus bairdi (Audubon). Baird's Sparrow

Anderson (1907) included this species on the basis of observations in Poweshiek County by Kelsey and Jones, and in Pottawattamie

County by Trostler. Recently it has been reported as observed in Polk County and in the Sioux City region. There are no specimens.

Aimophila aestivalis bachmani (Audubon). Bachman's Sparrow

Keyes and Williams (1889) listed this species upon the record of a set of eggs taken near Des Moines, Polk County, June 2, 1884. The bird was seen twice but was not secured. Anderson (1907) placed this species in his hypothetical list.

Junco oreganus shufeldti Coale. Shufeldt's Junco

To this species all of the reports of "Montana Junco" should probably be referred. A specimen was collected by W. E. Praeger in Illinois, opposite Keokuk. It is reported as a regular migrant in eastern Nebraska.

APPENDIX

This appendix contains thirteen species that were included in Anderson's "Birds of Iowa," but which are not contained in the present list. A statement concerning the reasons for removal is given for each species. Four others recently reported in Iowa are placed in this appendix.

Ixobrychus neoxenus (Cory). Cory's Least Bittern

One was reported by Mary L. Bailey at Spirit Lake, Dickinson County, August 23, 1930. This alleged species is now regarded as a melanistic phase of *Ixobrychus exilis*.

Plegadis falcinellus falcinellus (Linnaeus). Eastern Glossy Ibis

Of the two specimens listed by Anderson the one from Boone County cannot be found, and the one from Woodbury County was actually taken in Nebraska. It is in juvenal plumage, and probably is *P. guarauna*.

Branta canadensis minima Ridgway. Cackling Goose

This name is given to the Pacific coast subspecies, the smallest *Branta canadensis* occurring in the Mississippi Valley being known now as Hutchins's Goose, *B. c. hutchinsi* (Richardson).

Branta bernicla hrota (Müller). American Brant

There are a number of observations, in each instance unsupported by specimens. Undoubtedly, some of these refer to *Branta c. hutchinsi*.

Chen hyperborea atlantica Kennard. Greater Snow Goose

According to the A. O. U. Check-List, 4th Edition, the wintering and migrating range of this subspecies is along the Atlantic coast, with no records from the Mississippi Valley region. The extreme differences in size shown in a series of seventy-eight specimens examined by Anderson must now be considered as individual variation in *Chen h. hyperborea*.

Astur atricapillus striatulus Ridgway. Western Goshawk

B. H. Bailey recorded (Auk, XVIII, pp. 336-337) that two goshawks which were captured in Linn and Johnson counties were referable to this form. Recent examination of these specimens has proved them to be *A. a. atricapillus*, in a slightly juvenal plumage.

Buteo platypterus iowensis Bailey. Iowa Broad-winged Hawk

B. H. Bailey described (Auk, XXXIV, pp. 73-75) this alleged subspecies on the basis of specimens from Linn and Polk counties. These are now regarded as melanistic examples of *B. p. platypterus*.

Asturina plagiata plagiata Schlegel. Mexican Goshawk

Walter G. Savage recorded (Iowa Orni., I, p. 89) the capture of a female in Van Buren County, May 25, 1895. A painting, presumably of this bird, done by William Savage, is contained in the Iowa Historical Museum, Des Moines. The artist's inscription is "Gray Star Buzzard, Iowa, Wm. Savage." This painting was recently seen, and it proved to be one of a juvenal Broad-winged Hawk.

Callipepla squamata Brewster. Scaled Quail

Anderson (1907) included the record of one that was shot at Tabor, Fremont County, May 2, 1889. This must be considered as the recapture of an escaped caged bird.

Charadrius melodus circumcincta Ridgway. Belted Piping Plover

It is now considered as being the same as *Charadrius melodus*.

Catoptrophorus semipalmatus semipalmatus (Gmelin). Eastern Willet

There are no specimens of this Atlantic coast form. The early records of *Catoptrophorus semipalmatus* in Iowa were all recorded as the binominal, *inornatus* not having been described until 1887.

Larus atricilla Linnaeus. Laughing Gull

There are no specimens. It is probable that first year examples of *Larus pipixcan*, in which the primaries are black, have been confused with this species.

Columbigallina passerina (Linnaeus). Ground Dove

Clifford H. Pangburn recorded (Auk, XXXIX, p. 566) an observation of one at Des Moines, Polk County, June 10, 1922. The specimen was not taken.

Chordeiles minor henryi Cassin. Western Nighthawk

No specimens have been found that were referable to this race. Probably the field observations referred to Sennett's Nighthawk. The range of the bird now considered as *henryi* is in the Arizona and New Mexico region, the area to the north being occupied by *howelli*.

Dryobates villosus septentrionalis (Nuttall).

Northern Hairy Woodpecker

Anderson (1907) included this bird on the basis of eight specimens from Sioux City, Woodbury County, taken during December, 1884. These specimens were recently examined by H. C. Oberholser who considered them *villosus*.

Empidonax traillii alnorum Brewster. Alder Flycatcher

It is now considered as being the same as *E. t. traillii*. However, the common name "Alder Flycatcher" has been given to the latter.

Sialia maxicana bairdi Ridgway. Chestnut-backed Bluebird

It was included by Anderson (1907) on the basis of two sight records. There are no specimens.

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